THE EFFECTS OF CIRCULAR SINGER GESTURES ON ACOUSTIC AND PERCEPTUAL MEASURES OF MIDDLE SCHOOL AND HIGH SCHOOL CHORAL SINGING

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Abstract

The purpose of this study was to assess the effect of three singer conditions (low circular arm gesture, high circular arm gesture, no arm movement) performed by nine middle and high school choirs while singing. Recordings were analyzed on acoustic (long-term average spectra [LTAS]) and perceptual (singer and expert listener preferences) measures. Among primary findings: (a) results of a repeated measures ANOVA of LTAS data indicated a significant interaction effect; (b) entire spectrum grand mean and range differences between gestures comparisons indicate twelve pairings of more than 1 dB difference (Just Noticeable Difference); (c) more than half of the singer participants noticed differences in overall choral sound while using the high circular arm gesture; (d) participants in high school choirs noticed differences in individual vocal sound (80%) and overall choral sound (78%) when singing with the low circular arm gesture; (e) singer preference responses indicate 5 choirs preferred the high circular arm gesture, 3 choirs preferred singing without arm movement, and 1 choir reported a preference for the low circular arm gesture; (f) 63% of singer participants reported liking the addition of gestures while singing; (g) expert listeners ranked tone quality while performing with no arm movement highest for 5 choirs and while performing the low circular gesture highest for 3 choirs; and (h) 4 choirs received the same ranking from the expert listeners: (1) no arm movement, (2) high circular gesture, and (3) low circular gesture. Results were discussed in terms of comparisons of acoustic and perceptual measures, limitations of the study, and suggestions for further research.

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CHAPTER 1

Introduction

In the words of master choral educator, Rodney Eichenberger, "it is difficult to be uninvolved in the singing process if one's limbs are moving…if you get the body involved the mind cannot be far behind, because the mind has to be active for me to move my arms" (Wis, 1993). The combination of the mind and movement create success in retaining and gaining knowledge for a variety of learners. However, not all learners prefer kinesthetic modes; human beings favor different learning styles and techniques to acquire understanding, focus attention, and promote active learning for skill development. In the choral rehearsal, the addition of physical activities and kinesthetic movement enhances and informs student perception and can facilitate a student's learning and overall intellectual growth (Werner & Burton, 1979; Wis, 1993; Rosenbaum, 2010).

Movement in Learning

Johnson and Jones (2016) discuss how physical activity supports healthy child development by improving memory, concentration, and positive attitude. Students learn more efficiently when they are active and engaged. Adding movement to teaching/learning in the classroom may help students with creativity and overall intelligence. Students process movement in the same part of the brain that processes learning, thus physical movement such as standing, stretching, walking, or marching can help the brain focus. The addition of movement in the classroom also releases endorphins and can make students feel better and increase relaxation.

Martin and Murtagh (2017) suggest incorporating movement into classroom curriculum to serve as a way to assist student learning for individuals who participate in minimal movement activities outside of the school day. The integration of physical movement into academic lessons

may enhance concentration, cognition, on-task time, and academic achievement. When students participate in activities with physical movement they are motivated to concentrate and are more apt to enjoy the lesson.

Instructors should embrace kinesthetic learning regularly in the college classroom according to Mobley and Fisher (2014). They suggest that students benefit from alternative instruction styles incorporated into their everyday classes. The addition of kinesthetic movements would allow students to engage more fully with content and classmates. They recommend that an interactive learning environment can influence quality of education, peer relationships and communication skills.

Learning Through Movement in the Music Classroom

In the choral setting, singers and conductors assess and adapt during the rehearsal to improve tone quality, singer growth, and singing technique. Adding movement in the music education setting may increase overall effectiveness of teaching and learning. According to Zentgraf and Munzert (2009) when singers pay attention to the environmental effects of physical movement it can lead to a better performance than when a learner uses internal focus. Further, they argue that internal body-related attention-focus instructions can actually disrupt motor learning and performance. Without instructions, non-verbal gestures are used to learn task-relevant information, while verbal instructions provide redundant information. External instructions focusing on the effect of the movement are superior to external instructions that refer to non-movement-related aspects in the environment. For Zentgraf and Munzert, the addition of movement has infinite possibilities to help the mind and body.

Not only can body movement have an effect on the mind, body movement can affect vocal quality and technique. Johns (2002) discusses how movement compliments the voice and

how vocal-kinetic properties can be explained psychologically, neurologically, and philosophically. Johns seeks to evaluate the impact of movement on tone production, timbre, intonation, and breath to better understand the neurobiological basis of how movement and music affect each other. Johns discusses a direct relationship of movement upon singing and how both influence and enhance the other through the transfer effect of cognitive ability. He considers how moving improves the learning of vocal techniques because movement and singing are parallel systems that communicate with each other.

Dickson (1992) discusses the importance of singer participation in physical movement. He states that kinesthetic communication between conductor and singer is much more effective when singers participate. Dickson felt that the physical involvement of the singers heightens awareness of what singers are hearing and how they are producing tone. He suggests a three-stage methodology for teaching kinesthetics: (1) the body's response to music, (2) the conceptualization of music and its application in gesture, and (3) the incorporation of kinesthetics in the music making process.

Methods and Approaches That Incorporate Movement

The addition of student movement serves as a pedagogical tool in many classrooms and in several accepted methodologies in music education including the Kodály Method, Orff Approach, and Dalcroze Approach. Some music educators use these methods and techniques to successfully incorporate movement in the music classroom.

Kodály method. In the Kodály method, the use of hand signals, rhythmic pattern clapping, and physical movement allow students to be physically involved in music learning (Wis, 1993). Hand signs help singers develop inner hearing and the understanding of intervallic relationships. The hand signs provide a visual/spatial system for aural skills and are used to learn

new songs, reinforce concepts, and lead two-part singing. Hand signs help singers learn to read a music score at sight, which, in turn, helps singers internalize the height of a pitch by moving their hands upward or downward in accordance with the steps of the scale signified by a particular hand sign (Brunkan, 2012). The Kodály method also includes other forms of movement such as tapping and clapping. Teachers of this method encourage students to show an understanding of concepts including low/high and fast/slow through creative movement.

Orff approach. Carl Orff believes that music, movement, and speech are inseparable (Wis, 1993). A fundamental component of the Orff approach is learning through experience and linking new concepts or activities with what students already know such as clapping or stamping. Students physically and actively take part in music performance when following the Orff approach.

Dalcroze approach. Eurythmics, an aspect of the Dalcroze approach, enhances student learning of musical concepts through rhythmic movements. Émile Jaques-Dalcroze considers rhythm the fundamental basis for all life and the body's realization of rhythm as the basis of true music learning. Experiencing music at a deeper, physical level results in both a greater degree of musical learning and heightened memory of the learning (Wis, 1993). Dalcroze believes the source of music lies within human emotions and musical feelings depend on the intensity of our bodily sensations (Findlay, 1971).

Laban movement analysis. Researchers and educators continue to be influenced by the Dalcroze approach, including Rudolf Laban and his process of developing movement theories. According to Laban (1971), to understand rhythm and harmony singers must participate mentally and physically in the process. The Laban Movement Analysis (LMA) contains methods of examining the dynamic qualities of dance movement in a systematic and subjective manner.

Music educators often use LMA in the classroom and in music research. Hodgson and Preston-Dunlop (1990) report that Dalcroze's earlier theories on music teaching and movement clarify many of Laban's own ideas on rhythm and body awareness.

Movement in the Choral Warm-Up

Nancy Telfer, a composer and conductor, uses vocal warm-ups as a musical activity and not a technical, mechanical exercise. In an interview with Brendell (1997), Telfer suggests gestures work dramatically in musical activities, because changes are able to happen quickly and present long lasting results. Singers are able to support their voices and work together with their bodies when gestures are implemented in the rehearsal. She also uses full body or arm movements to release tension from the neck and throat. Telfer further discusses placement of sound as a physical sensation or a feeling. She believes that teachers should use images or physical action to change resonance and create a specific sound; singers then memorize the feeling in order to replicate the placement and the sound.

Physical movement can revitalize physical energy during the warm-up and develop a sense of musical flow while learning repertoire (Apfelstadt, 1985). Apfelstadt states that physical energy and body relaxation can help create vocal relaxation, including a feeling of physical buoyancy and energy, which produces an attitude of readiness in the singer. She also touts that physical metaphor and/or singer gesture can help instill a flowing line with forward momentum in the choral rehearsal.

Brinson (1996) suggests beginning a choral rehearsal with warm-up exercises that increase mental focus and various physical activities to release excess energy. Brinson contends that register consistency and range extension may show improvement with the addition of body movements. She mentions using physical activities in rehearsal to deepen the singers' level of

involvement in the music and allow the singers to release energy in constructive ways. She also suggests using physical and creative movement in the rehearsal to portray the mood of the piece and enhance the musical learning and understanding of the choir members.

Cooksey (2006) discusses the benefit of physical activity in vocal warm-ups, which include efficient and creative body/mind responses to music. Cooksey suggests including stretching exercises, body relaxation, bending, brain/body coordination, facial warm-ups, and body movements into the rehearsal. Cooksey advocates that singers use movements to internalize physical and emotional responses. He believes kinesthetic movement is effective when working for efficient tone and expressive singing.

Movement in the Choral Rehearsal

Body movement is a multimodal instructional tool and is effective when specific activities share the same quality as the desired musical response. According to Chagnon (2001), the rationale for using a movement-based teaching pedagogy is primarily from knowledge that conductors obtained by experimenting with various activities within rehearsals. Various vocal pedagogues techniques demonstrate the importance of physical activities when teaching students abstract musical concepts during the choral rehearsal. Students are able to develop an understanding of music by physically moving while singing, by watching others move, and by hearing changes in sound when singers move.

A conductor can build a repertoire of motions that will elicit certain musical ideas quickly and efficiently with careful attention to the connection between sound and gesture (Peterson, 2000). Rather than conducting patterns, Peterson suggests conductors should focus on gestures that show the aspects of weight, flow, and time in a phrase. To unify phrase endings, he proposes using movement as a nonverbal cue to unify the sound of a group with an upward hand gesture.

He touts that the use of movement to reinforce a concept may produce more significant results than verbal expression of the concept.

There are many beneficial qualities of movement in the music classroom and middle school choral rehearsal (Williamson, 2000). Williamson states that middle school adolescents have a great need for physical movement in the classroom and it may positively affect student energy through games and physical activity. Clapping, finger snapping and whole-body movements can all contribute to student focus and preparation in the middle school choral rehearsal.

Jost (2011) uses movement to (a) 'free up' singers in order to assist them in experiencing kinesthetically the direction of line and phrasing, (b) recognize rhythmic patterns and underlying dance rhythms with the body, (c) internalize syllables in a text, and (d) feel the mechanics of articulation. For Jost, physical movement and gesture are the keys to developing a feeling of freedom, an atmosphere of joy, and a sense of community in the choir.

Kinesthetically reinforcing a musical concept using hand movements with gesture, manipulatives, and metaphor may help to strengthen vocal technique, musicianship skills, and enhance artistic expression (Bailey, 2007). Bailey proposes that using physical movement in a rehearsal may also help with the development of artistic expression. When students are taught physical movements that embody the shape of an expression they are able to convey that expression with their voices more effectively.

Choral Methods Textbooks and Videotapes

Ehmann (1968) considers the body to be the instrument of the singer, and believes a singer uses his/her body to sustain life and to cultivate art. Ehmann thinks all choral singing involves movement, and all singing must physically express this energy and emotion. His

rehearsal techniques include numerous examples of physical activities intended to promote a better understanding of the total body process of singing, and uses them as a means of reinforcing rhythmic, melodic, and harmonic elements as well as the structure of phrasing of the music being rehearsed.

The text *Voice Building for Choirs* (1982) by Ehmann and Haasemann specifically focuses on the development of vocal technique in a choral ensemble and promotes the use of physical training as an important factor in the artistic process. Haasemann, a student of Ehmann, presents materials on rehearsal practices that involve movement. Haasemann and Jordan's instructional videotape, *Group Vocal Technique* (1989) provides a resource that promotes body movement as an integral part of the instructional process in the choral rehearsal.

Adams' (1991) videotape incorporates arm and hand gestures to reinforce verbal instruction from the conductor. The video includes verbal imagery to evoke physical expressions on the vocal process and gestures to visualize the sound the conductor is trying to achieve. Adams proposes larger circular arm motions help free and energize singing tone while smaller gestures help with tone placement, focus, and resonance.

Jordanoff's (1992) videotape demonstrates movement techniques to enhance group vocal instruction, improve comprehension of musical concepts, and promote expressive singing. The conductor's role as model and translator of the singers' motions into an appropriate conducting gesture in performance is a large part of Jordanoff's teaching. He deems that what the singer feels using his/her gesture has to be apparent for him/her through the symbols of the conductor's gesture.

Rao (1993) instructs readers on how to position the body, manage breath, and exercise the singing voice to produce musical tone. She believes that exercising, which requires

concentration, coordination, and control, prepares the body for singing. Rao encourages singers to use clapping, swaying, and conduct circular patterns to feel the music and gain rhythmic knowledge and fluency. She also encourages students to utilize conducting patterns in the choral rehearsal.

Need for Present Study

Minimal empirical evidence is available to validate the effect of singer movement on music performance. Much of the research on physical movement in the music classroom covers isolated details of the educational process, rather than implementation into the music classroom or rehearsal (Hibbard, 1994). Many choral directors use non-research-based literature to provide pedagogical structure. A strong foundation of supportive research about singer gesture and physical movement could assist in establishing the need for training and education of future choral and solo voice educators. Understanding the pedagogical results of movement and singer gesture could benefit choral music educators in implementing best practice in rehearsals.

Purpose of the Study

The purpose of this study was to assess the effects of singing with or without circular singer gestures (low circular arm gesture, high circular arm gesture) on acoustic (long-term average spectra) and perceptual measures (singer and expert listener preferences) of middle school and high school choral singing. The following research questions guided this investigation:

Research Questions:

1. Do long-term average spectra (LTAS) data indicate significant differences between performances of each of the choirs ($N = 9$) as they sang while performing with or without circular arm gestures (low circular arm gesture, high circular arm gesture)?

2. Do questionnaire responses show differences in singer perceptions of singing with or without circular arm gestures (low circular arm gesture, high circular arm gesture)?
3. Do expert listener rankings of recordings while performing with or without circular arm gestures (low circular arm gesture, high circular arm gesture) indicate significant differences/similarities of perceived choral tone?

Definitions

Gesture. Gesture is defined in the Oxford English Dictionary (2007) as a movement of part of the body to express an idea or meaning or an action performed to convey one's feelings or intentions.

Long-term average spectra (LTAS). Long-term average spectra gives an overall impression of an entire sung excerpt by identifying certain consistent features contained in the sound over time. Long-term average spectra represents timbre (quality of sound) and vocal features in singing and in speech. The data consist of the mean amplitude of each harmonic of a complex sound across a given time period. The information is averaged over time and includes both frequency and sound pressure density (amplitude intensity) across the spectrum of complex sound. Long-term average spectra graphs present sound pressure power as a function of frequency. Sound pressure level amplitude is presented according to a decibel scale. Frequency is presented as Hertz (the number of sound cycles per second). KiloHertz (kHz) serves as a shorthand way of expressing cycles per second for these partials as higher frequency partials may entail thousands of sound cycles per second. Long-term average spectra data provide a quantifiable index of sound quality across a specified period of time. These data can be useful for detecting persistent spectral events (Brunkan, 2012; Kenny & Mitchell, 2006).

CHAPTER TWO

Review of Literature

To date, few researchers have investigated the effects of singer gesture on acoustic and perceptual measures of choral sound. The research presented in this chapter utilized physical movement activities in the choral rehearsal and singer gesture as a pedagogical tool. Research in singer gesture, kinesthetic movements, and the use of singer gesture in the choral classroom guided this investigation. Quantitative data collection of more recent research regarding the effects of movement by choral singers and solo singers conclude this research.

Movement as a Pedagogical Tool

Hibbard (1994) used qualitative analysis procedures to develop a grounded theory of singer movement in choral rehearsals to identify and describe movement as a pedagogical tool. Hibbard performed a single-subject ($N = 1$), dual-site qualitative field study of a master choral conductor who used movement as an instructional technique with choral singers. Results suggested that the use of physical movement as an instructional technique with choral singers seemed to be an effective pedagogical tool because of kinesthetic memory. When a gesture was used in rehearsal, the singers remembered the physical experience and were able to evoke a similar vocal/physical musical response. Hibbard observed that singer-involved movements assisted the choir in creating musicality and in problem solving issues in vocal technique, intonation, and phrasing. Gestures provided visual, kinesthetic, and aural reference points for singers' to understand their tone production.

Hibbard found that physical movement engaged singers in an active, energized mode of music making. Singer movement contributed to an efficient rehearsal pace that allowed correction and reinforcement of certain aspects of vocal production. The addition of gesture to

the choral rehearsal provided a common mode of communication that identified problems, improved musical quality, and brought artistic expression in singers of varied musical abilities. When movement corresponded with the desired vocal or musical quality, Hibbard found an improved result.

Wis (1993) investigated the use of gesture and movement in the choral rehearsal as physical metaphor to facilitate learning and enhance musical experience. Wis observed two expert choral conductors, Haskett and Eichenberger, as they utilized movement in their choral rehearsals. Haskett used gestures in the warm-up process to develop a wide range of vocal skills, encourage concentration and focus, and release the psychological and physical barriers of the singing activity. Gesture and movement activities were used additionally with choral literature to help with particular vocal or interpretative problems.

In his interview with Wis, Eichenberger commented that early in his career he learned that if he kept singers active and moving in rehearsals he could keep students engaged and thus, used physical movement as his first solution to solve problems in rehearsal. Eichenberger attributed the effectiveness of movement activities in the choral rehearsal to multi-neural networking, a simultaneous coordination of body functioning during activity that is triggered by past experiences.

Wis (1993) reported that the use of gesture and physical movement made for more efficient communication between conductors and choristers, whereas verbal communication caused singers who already produced quality sounds to overcompensate and created new issues. Singer gesture could connect the abstract world to body function and natural, efficient singing. Wis concluded that physical metaphor made it possible for singers to stop thinking about the goal and let Mother Nature take over. Impossible tasks seemed to no longer be a problem,

because mental energy was redirected to something achievable for the singer.

Chagnon (2001) examined bodily-based activities in the choral rehearsal. He compared the data of two empirical studies reported by Hibbard and Wis to determine the reasons for using movement in the choral rehearsal. His collective case study investigated how three additional choral directors used movement-based activities in choral settings. Chagnon collected data from rehearsal observations and interviewed the five directors and choir members.

Results indicated that movement was an effective instructional technique in the choral rehearsal. Body movement modified a variety of musical qualities, promoted efficient vocal production and relaxation, improved vocal skills and energy, and refined qualities associated with choral singing such as vowel formation and improved resonance. Physical activities promoted a higher level of learning, heightened the concentration of individuals, and unified the group's focus. Movement helped singers develop rhythmic accuracy, express the flow and intensity of the musical line, improve blend, and create a sense of ensemble. The kinesthetic experience of moving heightened singers' awareness of the musical elements notated in the score, which helped the singers understand music as a whole. The singers in these rehearsals responded that they consistently felt more effective while singing using physical movement.

Manganello (2011) completed a participant-observation case study of expressivity and movement in the middle school choral rehearsal. Participants involved one choral director and two middle school choruses during a single semester of instruction. Both ensembles were mixed choruses; choir one (n=71) included 29 male and 42 female seventh and eighth grade students and choir two (n=70) comprised sixth grade students (males, n = 22; females, n = 48). Observations in this study indicated that the kinesthetic movements (representing qualities of dynamics, phrasing, breathing, articulation, and interpretation), vocal routine, and conductor

gestures helped choral students focus, develop social skills, and bring deeper meaning to musical understanding in the rehearsal. Through body movement, the director enabled students to understand concepts and interpretations of their musical experience.

Manganello observed physical warm-ups that released tension in the body, relaxed breathing, and created focus in middle school singers. Singer participant perceptions agreed with his findings. With movement, vocal issues in the choral repertoire were solved and students performed the music more efficiently. Manganello found that student comprehension and understanding were achieved at a faster rate with kinesthetic learning in the choral rehearsal and singing was also achieved on a deeper and more expressive level.

Krudop (2003) investigated the effect of kinesis conducting gestures on expressive ensemble response. Krudop used the Ekman-Friesen Classification of Non-Verbal Behavior to categorize the kinesis movements in the study. He video recorded choirs ($N = 8$) with varying ages and experiences (3 college/university, 3 high school, and 2 community choirs) performing with a conductor using a neutral gesture and again while employing a heightened level of kinesics to show varying levels of expression in performance. A panel of expert listeners ($N = 5$) agreed that application of kinesis gestures was effective in eliciting a more emotionally expressive response from the ensembles.

When comparing expert listener responses for all video taped choirs the majority of expert listeners ($M = 78\%$) agreed that when the conductor applied kinesis gestures the ensembles displayed higher level of unified emotional response and increased emotional intensity. Half of the expert listeners observed that choral singers responded with an increase in ensemble confidence when the conductor applied kinesis gestures. Krudop's findings highlighted the importance of effective non-verbal communication between conductor and ensemble,

primarily its necessity for the message of the music to be transmitted to the audience in an expressive, artistic manner. The expert panel's responses indicated that sufficient technical preparation is necessary before effective emotional responses are possible and allows choirs to respond more expressively to gestures.

Nafisi (2010) examined singer gestures that successfully conveyed complex vocal and musical concepts to aid in pedagogical instruction. Five voice teachers were videotaped during university-level singing lessons ($N = 18$) to measure usage of gestures in the communication of singing related concepts. Nafisi categorized four types of gestures for teaching voice including: technical (later labeled body-movement), musical, physiological, and sensation-related.

Technical gestures assisted in the explanation of a physiological mechanism or an acoustic phenomenon. Musical gestures communicated musical concepts such as phrasing, emphases, or articulation. Physiological gestures mirrored the teachers' knowledge and perception of what was happening invisibly inside his/her body when singing. Sensation-related gestures represented a particular sensation or a visible form to a thought or sensation. The results indicated that gesture played a role as a teaching and communication tool in the singing studio in 4 out of 5 ($n = 80\%$) of voice teacher's studios.

Nafisi (2014) later investigated the use of physical gestures and body-movement as teaching and learning tools in voice teaching. Participants ($N = 148$) in two professional voice-teaching organizations in Germany and Australia responded to a researcher-designed questionnaire. Results showed almost all voice teachers (99.3%) reported using gestures to enhance explanation and/or as demonstration. Reports of body-movements were reported more frequently than any other gesture types in the private voice studio. All respondents (100%) agreed that utilizing singer body-movements whilst singing raised singer awareness and helped

to release tension.

Empirical Research of Singer Gesture and Physical Movement

In a recent study by Cook-Cunningham and Grady (2017a), researchers investigated the effects of three warm-up procedures on acoustic and perceptual measures of choir sound with collegiate choirs ($N = 3$). Long-term average spectra results demonstrated more resonant singing after completing the warm-up that included both physical and vocal warm-up procedures for two of the three choirs. Pitch analysis indicated better intonation or "in-tune" singing after performing the physical/vocal warm-up. Singer questionnaire responses showed general preference for the physical/vocal warm-up combination.

Cook-Cunningham and Grady (2017b) replicated the previous study with younger populations. Three choirs were examined, two children's choirs and one high school choir, yielding similar results to the first investigation. All choirs overall preferred the physical/vocal combination and LTAS revealed that each ensemble sang with more resonant energy after participating in the physical/vocal combination warm-up.

Brunkan (2013) investigated the effects of three conducting gestures that were or were not replicated by singers on intonation and perceived tone quality of individual singers ($N = 58$). Participants performed *Happy Birthday to You* while watching a videotaped conductor who employed three different conducting gestures. A control group ($n = 19$) practiced singing to the sound of a metronome, an experimental group ($n = 19$) received gestural training by practicing with a videotaped instructor, and a second experimental group of singers ($n = 20$) physically replicated the conductor gestures while singing. Results indicated statistically significant intonation changes with gesture groups during the posttests. Expert panel ($n = 10$) ratings indicated that the most balanced singer tone quality occurred while the singers observed or

performed with gesture. Singer perceptions indicated changes in breath support and tone quality with the addition of singer gesture.

Part of Brunkan's (2016) research analyzed fundamental frequency differences by standard acoustic and perceptual measures when individual singers ($N = 49$) performed with singer gesture or with no movement. Most singers ($n = 33$, 67.37%) were closer to the target fundamental frequency when using singer gesture, and the majority of those singers ($n = 31$, 93.94%) made an audible change in their fundamental frequency when adding movement to their singing. Perceptual responses indicated changes in breath support and volume (amplitude) from a large number of participants and additional perceptual changes in vibrato, tone, and rhythm.

Grady and Cook-Cunningham (2018) investigated the effects of choral warm-ups with and without singer gesture on LTAS, intonation, and perceptions of four choirs. Singers participated in two choral warm-up videos during separate rehearsals and were recorded singing a folk song for analysis. Results showed statistically significant differences in LTAS results between with and without singer gesture. Perceptual analysis indicated the majority of singers in all four choirs preferred the warm-up with singer gesture to the warm-up without singer gesture.

A portion of Brunkan's (2012) dissertation assessed the potential effects of three singer gestures on performances of choral singers ($N = 31$). Brunkan measured acoustic (LTAS) differences in choral sound across various conditions. Results indicated a significant increase in mean signal amplitude with specific singer gestures. The low, circular arm gesture appeared to be associated with changes in both timbre and relative amplitude. With regard to timbre and amplitude, gestural conditions were ranked higher among the expert panel when compared to recordings without singer gesture. The majority of singer participants wrote positive comments regarding the use of gesture during choral singing. Choral singer participants in Brunkan's study

indicated a 97% agreement that gestures positively affected vocal sound. Results indicated that singer gestures might be more effective when singers feel a level of comfort performing the motion.

CHAPTER THREE

Methods

The purpose of this study was to assess the effects of singing with or without circular singer gestures (low circular arm gesture, high circular arm gesture, no arm movement) on acoustic (long-term average spectra) and perceptual measures (singer and expert listener preferences) of middle school and high school choral singing. This chapter details the participants, procedures, and equipment employed in this investigation.

Singer Participants

Choral singer participants (N = 149) comprised a middle school (n = 74) and high school (n = 75) choral program in grades six through twelve within a suburban community in the Midwest. Participants constituted male (n = 37) and female (n = 112) singers with an age range of 11-20 years (M = 14.50). All singers were currently enrolled in middle school or high school choir. Prior student singing experience in the choirs was reported as 1–9 years (M = 4.34), and 23 students (15%) reported private voice study (M = 0.34 years). Legal guardians of the participants completed an Institutional Review Board (IRB) pre-approved consent form (Appendix A) and singer participants completed a brief demographic questionnaire (Appendix B).

Nine choirs participated in this investigation including three high school choirs and six middle school choirs. Choirs by age and voicing: Choir A (HS-SATB), Choir B (HS-SAB), Choir C (HS-SSAA), Choir D (MS-SATB), Choir E (MS-SAB), Choir F (MS-SAB), Choir G (MS-SAB), Choir H (MS-SA), and Choir I (MS-SA). All high school choirs (n = 3) rehearsed every school day for 50 minutes. Middle school choirs (n = 6) rehearsed on an alternating daily scheduling that allowed students a 47-minute rehearsal one to three days a week.

Expert Listener Participants

A panel of choral teachers and private voice instructors ($N = 8$) participated in this investigation as expert listeners. Experts had a mean of 7.88 years (range = 3-20 years) of experience working with choral singers, a mean of 3.75 years (range = 0-20 years) of experience teaching general music, and a mean of 7.13 years (range = 1-25 years) of experience teaching private voice. Listeners were male ($n = 4$) and female ($n = 4$) ranging in age from 24-48 years ($M = 31$ years) (Appendix C).

Sung Musical Excerpt

The musical excerpt (Figure 1) utilized in this investigation was the Alma Mater of the high school. This melody was selected because it: (a) was likely to be known by most participants, (b) had a moderate tempo, (c) contained a vocal range appropriate for unchanged, changing, and changed voices (range = E4 to D5), and (d) required minimal skill to sing intervals (largest interval = perfect fifth). The melody was rehearsed in each choir during five class periods prior to the recording session. The researcher led the students through a brief vocal warm-up and run-through of the melody using a standard conducting pattern of consistent plane and size. A metronome with a blinking light insured consistency of tempo. At the recording session, each choir could sing the musical excerpt from memory.

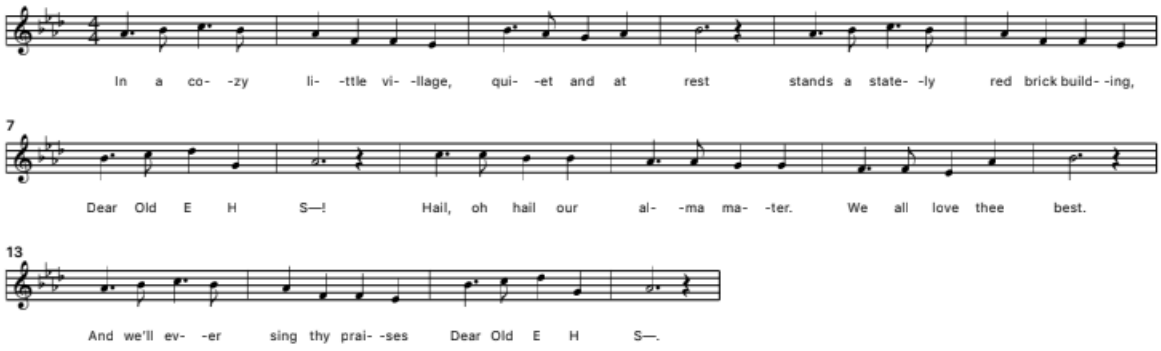

Figure 1. Musical excerpt.

Definition of Circular Singer Gestures and No Arm Movement Position

Low circular arm gesture. Participants stood and utilized both hands and arms for the gesture. Starting position included arms extended approximately 18 inches from the belly button, with palms facing the body and fingertips of right and left hands approximately 6 inches apart. Keeping fingertip distance and palms facing the body, hands circled down and towards the body, and when close to the body, up and away from the body completing a circle. The height of the gesture remained between the hips and the bottom of sternum. The circular rotation occurred every beat in the musical excerpt (mm. 62). See Figure 2.

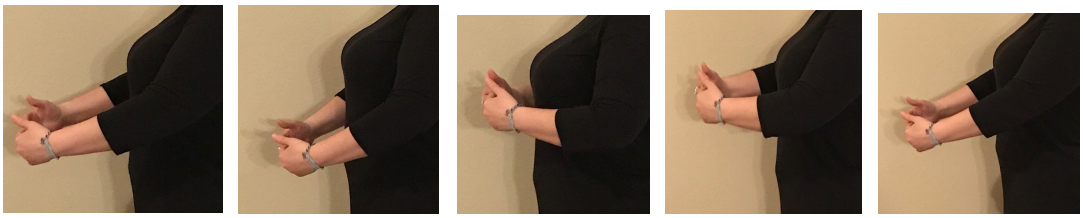

Figure 2. Low circular arm gesture (starting point right, proceeding through gesture pictured right to left).

High circular arm gesture. Participants stood and utilized both hands and arms for the gesture. Starting position included arms extended approximately 18 inches from the face, with palms facing the body and fingertips of right and left hands approximately 6 inches apart.

Keeping fingertip distance and palms facing the body, hands circled down and towards the body, and when close to the body, up and away from the body completing a circle. The height of the gesture remained between shoulders and 2 inches above the top of the head. The circular rotation occurred every beat in the musical excerpt (mm. 62). See Figure 3.

Figure 3. High circular arm gesture (starting point right, proceeding through gesture pictured right to left).

No arm movement position. Participants stood with arms relaxed and freely hanging at the singer's sides with palms facing the body. See Figure 4.

Figure 4. No arm movement position.

Recording Spaces and Standing Arrangements

Two choral rehearsal spaces were utilized in this investigation. Choirs recorded in their regular rehearsal space while standing in their routine rehearsal formation (Figure 5). Singers stood on choral risers in a three-row formation with a minimum of 24-inch lateral spacing between singers. In all cases, voice sections within each choir contained at least three singers, the minimum number required for a chorusing effect to occur (Ternstrom & Karna, 2002).

Choir A (HS-SATB)

S S S T T T A A B B
S S T T A A A B B
S S S T T A A B B

Choir B (HS-SAB)

S S S A A B
S S S A A B B
S S S A A B

Choir C (HS-SSAA)

S1 S1 S2 S2 S2 A1 A1 A2 A2
S1 S1 S1 S2 S2 S2 A1 A1 A2
S1 S2 S2 S2 A1 A1 A2 A2 A2

Choir D (MS-SATB)

S S T T A B
S S T A B
S A A B

Choir E (MS-SAB)

S A A A B B
S A A A
S S A A A

Choir F (MS-SAB)

S S B A A
S B A A
S S B A

Choir G (MS-SAB)

S S A
A A
S B

Choir H (MS-SA)

S S A A A
S S A A
S S A A A

Choir I (MS-SA)

S A A A
S S A A
S S A

Figure 5. Choral riser position for High School (*n* = 3) and Middle School (*n* = 6) choirs.

Conductor Video Recording Session

The stimulus videos ($N = 3$) for this investigation each contained two portions: (1) a demonstration of the circular singer gesture or no arm movement position to be performed, followed by (2) a conductor directing the musical excerpt. The same conductor was in all stimulus videos, wore black, and did not use a baton. During the conductor video recording session, the researcher played an audible metronome at 62 mm. to ensure that the conductor demonstration of singer gestures and tempo of conducted stimuli remained consistent. An iPad captured the recorded conducting performance. The camera recorded a mid-thigh to above the head view of the conductor to ensure that all circular singer gestures, no arm movement position, and conducting gestures were within the screen.

Demonstration of circular gestures and no arm movement videos. The conductor demonstrated both circular singer gestures and the no arm movement position in separate videos. In the videos for the low circular arm gesture and the high circular arm gesture, the entire gesture was repeated 64 times with the quarter note equaling one complete gesture at a metronome setting of 62 mm.

Directing the musical excerpt video. The conductor started and ended her conducting session with hands at her sides and directed the musical excerpt with a neutral facial expression and basic conducting pattern in 4/4 meter. The conducted portion remained the same in all three stimulus videos.

Singer Recording Session

A projected image of the conductor was placed 15 ft (4.572 m) from the front step of the choral risers, a distance commonly assumed by the conductor during choir rehearsals. This distance also ensured that the projected conductor was life-sized. A Roland R-05 digital sound

recorder captured each performance at a sampling rate of 44.1 kHz (16 bits) in .wav format. The recorder was placed 12 ft (3.66 m) from the front row of the choir, in a mixed to diffuse sound field, at a height of 5 ft 4 in. (1.63 m) or approximate conductor ear height. Volume and gain controls, set manually at the beginning of each recording session, remained the same throughout all recordings.

Upon entering the rehearsal space, singers took their usual rehearsal standing positions on the choral risers. The researcher ensured the minimum distance of 24 in between singers with pre-measured dowel rods.

The researcher recorded each choir singing the excerpt while using (a) low circular arm gesture (b) high circular arm gesture, and (c) no arm movement. The order of stimulus video presentation was counter-balanced for each of the nine choirs. Prior to each performance, singer participants heard the first three pitches of the melody in tempo sounded by an acoustic piano. After each performance, singers immediately responded to a singer questionnaire.

Singer Questionnaire

After each recording (n = 3) the singer participants in each choir completed a questionnaire (Appendix B). Singer participants were asked if they noticed a difference in their individual vocal sound and if they noticed a difference in their overall choral sound while singing with singer gestures or without singer gestures. On a scale of 1-5 each singer participant rated how effective he/she found the circular singer gestures or no arm movement to be (anchored with *not helpful* to *very helpful*) while singing. Once all three recordings were completed choral singers were asked to respond if they enjoyed the singer gestures and were encouraged to write open-ended comments about the recording session and the experience.

Post Choir Recording Session Analyses

Long term average spectra measurements. The researcher obtained long term average spectra (LTAS) data through KayPentax Computerized Speech Lab (CSL) software using a window size of 512 points with no pre-emphasis or smoothing, a bandwidth of 86.13 Hz, and a Hamming window. Data was transferred to an Excel spreadsheet for subsequent statistical analyses.

Expert Listeners

Expert listeners ($N = 8$) ranked the three recordings for each choir according to auditory sort-and-rank procedures created by Confredo, Geringer, Flowers, Brittin, and Parisi (2018). A Google Form was generated by the researcher and then disseminated through email to choral instructors and private voice educators. The first section in the Google Form requested demographic information including years of teaching general music, solo voice, and choral music.

Each section that followed contained three auditory recordings for a single choir. The recordings were 15 seconds long and comprised measures 8-12 of the musical excerpt. Recordings were counter-balanced for each section and were labeled with colors. Auditors could listen to each recording as many times as desired and then ranked the three recordings. The listeners ranked the recordings from 1 to 3 according to overall choral tone quality (1 represented the most pleasing choral tone quality).

Data Analysis

Research question 1: LTAS. I reported grand mean differences and ranges for each of the recording comparisons under circular arm gestures and no arm movement. I completed a 9 (choirs) x 3 (high circular arm gesture, low circular arm gesture, or no arm movement) repeated

measures analysis of variance (ANOVA) of all LTAS data.

Research question 2: Singer perceptions. I noted percentage of yes/no responses to the questions about noticing differences in individual singing and choral sound. I found the mean and range of singer-rated effectiveness of singing with or without circular singer gestures and averaged the ranking of the three conditions. I disseminated discrete comments into the categories “positive” and “negative” in terms of singer preferences.

Research question 3: Expert listener perceptions. I reported grand mean differences and ranges for each of the recording comparisons under the three singer gesture conditions. I compared ranking results for the high school and middle school programs separately.

CHAPTER FOUR

Results

Results are presented according to the research questions posed for this investigation.

Research Question One: Choral Sound According to Long-Term Average Spectra

The first research question inquired about acoustic differences between choir performances while singing with a high or low circular gesture or no gesture according to long-term average spectra (LTAS). Results are presented with reference to the entire spectrum (0 – 10 kHz). For LTAS charts of each of the nine choirs see Appendix D.

Results of a 9 (choirs) x 3 (gestures) repeated measures ANOVA indicated a significant interaction effect (F [1, 116] = 370.324, $p < .021$). Entire spectrum grand mean and range differences between (a) high circular gesture and low circular gesture, (b) no movement and high circular gesture, and (c) low circular gesture and no arm movement are reported in Table 1.

Table 1

Long-Term Average Spectra Grand Mean and Range Differences According to Choir

Choir	H vs L		N vs H		L vs N	
	Mean (dB)	**Range (dB)**	**Mean (dB)**	**Range (dB)**	**Mean (dB)**	**Range (dB)**
A	0.40	0.01 - 2.50	0.43	0.02 - 1.88	0.03	0.00 - 1.67
B	**1.24**	0.03 - 3.98	**2.27**	0.22 - 3.66	**3.51**	0.14 - 6.88
C	0.91	0.02 - 2.61	**1.42**	0.15 - 3.00	0.50	0.02 - 2.22
D	0.15	0.02 - 1.94	0.82	0.18 - 1.82	0.67	0.00 - 2.43
E	0.02	0.00 - 0.26	**1.06**	0.07 - 2.89	**1.08**	0.00 - 2.92
F	0.75	0.02 - 2.05	0.97	0.02 - 2.56	**1.72**	0.05 - 3.30
G	**1.49**	0.03 - 4.93	**1.49**	0.03 - 4.07	**2.99**	0.01 - 8.07
H	**1.54**	0.05 - 3.55	**1.27**	0.06 - 3.15	0.27	0.00 - 1.44
I	0.82	0.02 - 2.39	0.75	0.01 to 2.8	0.06	0.01 - 1.38

Note. H = High Circular Arm Gesture, L = Low Circular Arm Gesture, N = No Arm Movement. Grand mean differences that are more than 1 dB (JND) are highlighted in bold font.

Howard and Angus (2006) suggested that differences of 1 dB in the amplitude of complex sound may establish 'noticeable differences' (Just Noticeable Difference, JND) for

human hearing. Thus, long-term average spectra amplitude differences exceeding 1 dB are of particular interest.

When comparing the high circular gesture to the low circular gesture, grand mean differences larger than 1 dB were found for three choirs: Choir B (M = 1.24), Choir G (M = 1.49), and Choir H (M = 1.54). While comparing the results of performing with no arm movement to the high circular gesture five choirs displayed more than 1 dB differences: Choir B (M = 2.27), Choir C (M = 1.42), Choir E (M = 1.06), Choir G (M = 1.49), and Choir H (M = 1.27). Singing with the low circular arm gesture in comparison to singing with no arm movement displayed larger than 1 dB JND in four choirs: Choir B (M = 3.51), Choir E (M = 1.08), Choir F (M = 1.72), and Choir G (M = 2.99).

When analyzing LTAS results in the middle school choirs, 50% of the choirs showed higher spectral energy overall in the recordings using no arm movement. Long-term average spectra results for the remaining middle school choirs did not establish conclusive differences between singing with or without singer gesture. In contrast, high school Choir B demonstrated the lowest spectral energy in the recording without arm movement. The other two high school ensembles demonstrated inconclusive shifts in spectral energy throughout the recordings when comparing singing with or without singer gesture.

Research Question Two: Singer Perceptions

The second research question asked whether differences existed in singer perceptions of the three gestures while singing. Upon conclusion of each recording session, choral singers completed a questionnaire, which requested for singers to respond with overall preferences concerning the inclusion of gestures while singing. Tables 2 and 3 contain singer responses to yes/no questions posed about differences in individual and choral sound.

Table 2

Results for Questionnaire Question (a) Did You Notice a Difference in your Vocal Sound (Yes or No)?

	High Circular Arm Gesture	Low Circular Arm Gesture	No Arm Movement
Choir A	75% yes, 25% no	64% yes, 36% no	50% yes, 50% no
Choir B	79% yes, 21% no	89% yes, 11% no	26% yes, 74% no
Choir C	78% yes, 22% no	89% yes, 11% no	41% yes, 49% no
Choir D	60% yes, 40% no	87% yes, 13% no	53% yes, 47% no
Choir E	60% yes, 40% no	67% yes, 33% no	53% yes, 47% no
Choir F	69% yes, 31% no	62% yes, 38% no	77% yes, 23% no
Choir G	71% yes, 29% no	43% yes, 47% no	57% yes, 43% no
Choir H	43% yes, 57% no	50% yes, 50% no	57% yes, 43% no
Choir I	45% yes, 55% no	36% yes, 64% no	36% yes, 64% no

Table 3

Results for Questionnaire Question (b) Did You Notice a Difference in the Choral Sound (Yes or No)?

	High Circular Arm Gesture	Low Circular Arm Gesture	No Arm Movement
Choir A	71% yes, 29% no	75% yes, 25% no	54% yes, 46% no
Choir B	84% yes, 16% no	79% yes, 21% no	42% yes, 48% no
Choir C	81% yes, 19% no	81% yes, 19% no	48% yes, 52% no
Choir D	80% yes, 20% no	67% yes, 33% no	53% yes, 47% no
Choir E	80% yes, 20% no	47% yes, 53% no	40% yes, 60% no
Choir F	69% yes, 31% no	38% yes, 62% no	54% yes, 46% no
Choir G	86% yes, 14% no	43% yes, 47% no	57% yes, 43% no
Choir H	50% yes, 50% no	50% yes, 50% no	29% yes, 61% no
Choir I	55% yes, 45% no	18% yes, 82% no	27% yes, 73% no

In all choirs at least half of the singer participants noticed a choral sound difference when singing using the high circular gesture. The high school singer participants (77%) responded that they noticed differences in their individual vocal sound while using the high circular arm gesture. While singing and using the low circular arm gesture, the majority of high school singers (Choir A, Choir B, and Choir C) noticed differences in vocal sound (80%) and choral sound (78%). While singing and using the low circular arm gesture, middle school singers noticed differences in individual vocal sound (58%) and in overall choral sound (44%).

After each completed recording session, singer participants responded to a question concerning the effectiveness of singing with the high circular arm gesture, the low circular arm gesture, and no arm movement. Participants responded on a scale of 1 to 5 (not helpful to very helpful). See Figure 6.

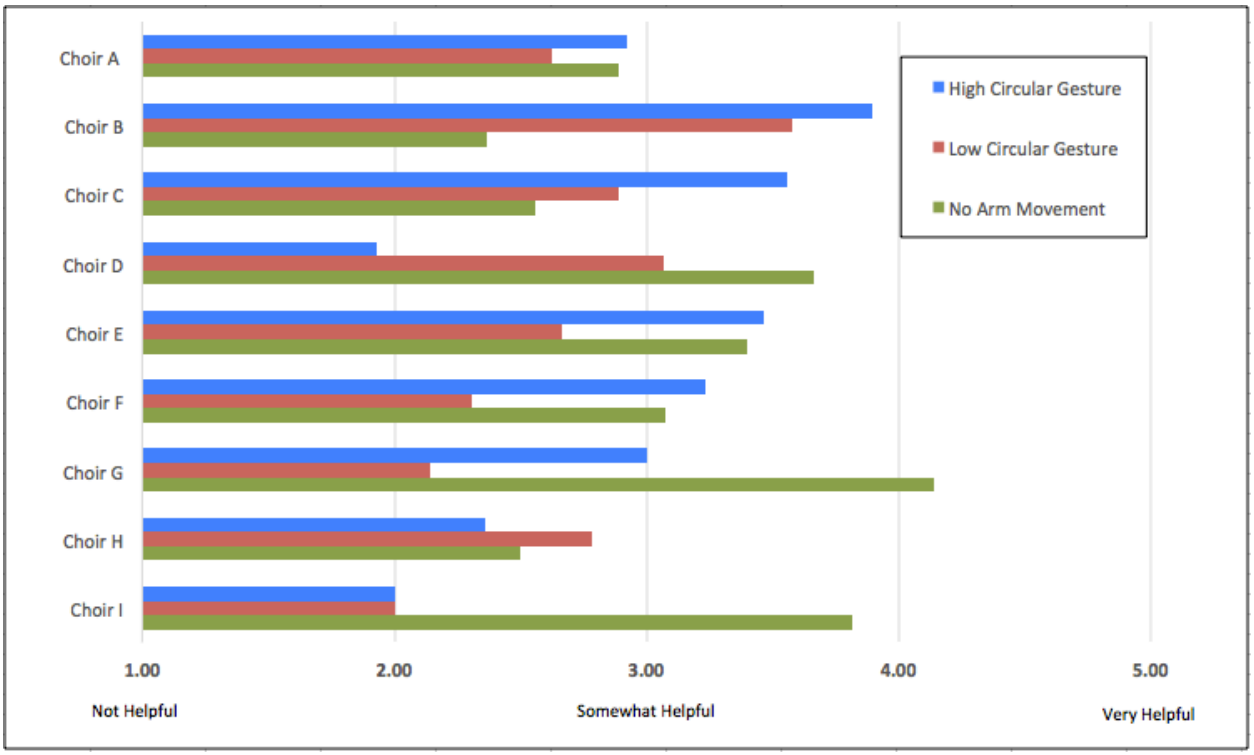

Figure 6. Singer participant perceptions of the effectiveness of high circular arm gesture, low circular arm gesture, and no arm movement on a scale of 1 to 5 (not helpful to very helpful).

All three high school choirs ranked the high circular gesture overall to be most effective when singing with or without gestures. Two of the high school choirs reported singing without gestures to be least effective. One middle school choir (Choir H) perceived the low circular arm gesture to be most effective while performing the excerpt. Three of the middle school choirs found singing without arm movement to be the most effective way to sing the excerpt.

Overall singer responses indicated that five of the nine choirs perceived the high circular arm gesture to be more effective and helpful for singing. Three of the nine choirs (no high school

choirs) on average reported no arm movement to be more effective for singing than singing with circular singer gestures.

After completing all three of performances, singer participants responded to a final question and an open-ended request for comments. The question inquired if singers enjoyed the addition of singer gesture; 63% (n = 94) of singers answered yes, and 37% (n = 55) of singers answered no.

The open-ended question requested reflections on participants' likes or dislikes about singing while demonstrating circular gestures. I disaggregated discrete comments (N = 202) into two categories of "positive comments" and "negative comments" for overall opinions of singing with and without singer circular gestures.

Positive comments (n = 111, 55%) mostly related to improved choral tone quality (n = 19), tempo (n = 17), and breath support (n = 13). Some trends appeared throughout the positive comments with themes of "improved singing," "more singer resonance," "better vowel and mouth shape," "improved phrasing," and "improved singer focus." A few singer participants commented on the overall enjoyment of trying something new and singing while doing gestures. Some students commented about enjoying the simplicity of the gesture and how it seemed to make singing easier.

Negative comments (n = 91, 45%) mostly related to singer distraction (n = 23), tempo issues (n = 13), and physical fatigue (n = 12). In addition to the previous categories, singer participants responded, "difficulties with breath support," having to "exude excessive amounts of effort," and an inability to "focus on the conductor."

Many of the middle school aged participants preferred singing without gesture (no arm movement) and believed that the gestures made "singing more difficult." Some participants (n =

4) mentioned feeling "discomfort in their singing voice" or "additional tension" while singing with physical movements. A common statement from middle school aged participants was a preference for standing still while singing.

Research Question Three: Expert Listener Perceptions

The third research question asked whether significant differences were found in the expert listener perceptions of choral tone quality with or without the use of circular singer gestures. Table 4 and 5 contain expert listener mean rankings of choral sound of the three singer gesture recordings for each choir delineated by high school and middle school.

Table 4

Expert Listener Mean Rankings of High School Choir Recordings

Ranking	Choir A	Choir B	Choir C
1	N ($M = 1.25$)	H ($M = 1.63$)	L ($M = 1.75$)
2	H ($M = 2.25$)	L ($M = 2.00$)	H ($M = 2.13$)
3	L ($M = 2.63$)	N ($M = 2.38$)	N ($M = 2.13$)

Note. H = High Circular Arm Gesture, L = Low Circular Arm Gesture, N = No Arm Movement.

Expert listener rankings (87%) for Choir A selected no arm movement to have the most pleasing choral tone quality, while the low circular arm gesture was ranked least pleasing tone quality (63%). Choir B demonstrated different results, with the high circular arm gesture recording ranked most pleasing overall by expert listeners (63%) and no arm movement ranked least pleasing overall by expert listeners (50%). For Choir C, expert listeners (75%) ranked the circular gestures to have more pleasing choral tone quality overall and found the no arm movement (38%) to have the least pleasing tone quality.

Table 5

Expert Listener Mean Rankings of Middle School Choir Recordings

Ranking	Choir D	Choir E	Choir F	Choir G	Choir H	Choir I
1	N ($M = 1.63$)	N ($M = 1.25$)	L ($M = 1.75$)	N ($M = 1.50$)	N ($M = 1.38$)	L ($M = 1.63$)
2	H ($M = 2.13$)	H ($M = 2.00$)	N ($M = 1.88$)	H ($M = 1.88$)	L ($M = 2.00$)	H ($M = 2.13$)
3	L ($M = 2.25$)	L ($M = 2.75$)	H ($M = 2.38$)	L ($M = 2.63$)	H ($M = 2.63$)	N ($M = 2.25$)

Note. H = High Circular Arm Gesture, L = Low Circular Arm Gesture, N = No Arm Movement.

On average, most expert listeners (67%) ranked the middle school recordings with no arm movement to have the most pleasing choral tone quality. Expert listeners (25%) ranked the low circular arm gesture to have the most pleasing choral tone quality in two of the middle school choirs. Expert listeners did not rank the high circular arm gesture to be most pleasing in any of the middle school choir recordings. When comparing results, three of middle school choirs were ranked on average with the same results: (1) no arm movement, (2) high circular gesture, and (3) low circular gesture.

Summary of Results

Results of a 9 x 3 repeated measures ANOVA of LTAS data indicated a significant interaction effect (F [1, 116] = 370.324, $p < .021$). When comparing the high circular gesture to the low circular gesture, grand mean differences larger than 1 dB were found for three choirs. While comparing the results of performing with no arm movement to the high circular gesture five choirs displayed a more than 1 dB difference. Singing with the low circular arm gesture in comparison to singing with no arm movement displayed larger than 1 dB JND in four choirs.

In all choirs at least half of the singer participants noticed a choral sound difference when singing using the high circular gesture. The high school singer participants noticed differences in their individual vocal sound while using the high circular arm gesture. While singing and using the low circular arm gesture, the majority of high school singers noticed differences in individual

vocal sound and choral sound. While singing and using the low circular arm gesture, middle school singers noticed differences in individual vocal sound and in overall choral sound.

High school choirs ranked the high circular gesture overall to be most effective. Two of the high school choirs reported singing without gestures to be least effective. Three of the middle school choirs found singing without arm movement to be the most effective way to sing the excerpt. Overall singer responses indicated that five of the nine choirs perceived the high circular arm gesture to be more effective and helpful for singing. Sixty-three percent of singer participants responded that they enjoyed the addition of singer gesture while singing.

Overall expert listener mean rankings indicated five choirs were ranked highest on choral tone quality while performing with no arm movement, while three choirs were ranked highest on choral tone quality while performing the low circular gesture. Four of the nine choirs were ranked as follows: (1) no arm movement, (2) high circular gesture, and (3) low circular gesture.

CHAPTER FIVE

Discussion

This investigation documents acoustic measurements of choral ensembles ($N = 9$) while singing with or without singer circular gestures (high circular arm gesture; low circular arm gesture; no arm movement) and perceptual measurements of singer participants and expert listeners. Some music pedagogues (Wis, 1993; Brendell, 1997; Cooksey, 2006; Bailey, 2007) report that the incorporation of singer gesture generates positive contributions in overall vocal sound. Some findings in this study suggest that the addition of singer gesture may support those claims. However, results also indicate that there is more research to be done on singer gesture and how it may or may not affect choral singing.

Among primary findings: (a) results of a repeated measures ANOVA for LTAS data indicated a significant interaction effect; (b) entire spectrum grand mean and range differences between gestures comparisons indicate twelve pairings of more than 1 dB difference (Just Noticeable Difference); (c) more than half of the singer participants noticed differences in choral sound while using the high circular arm gesture; (d) participants in high school choirs noticed differences in individual vocal sound (80%) and overall choral sound (78%) when singing with the low circular arm gesture; (e) singer preference responses indicate 5 choirs preferred the high circular arm gesture, 3 choirs preferred singing without arm movement, and 1 choir reported a preference for the low circular arm gesture; (f) 63% of singer participants reported liking the addition of singing with gestures; (g) expert listeners ranked tone quality while performing with no arm movement highest for 5 choirs and while performing the low circular gesture highest for 3 choirs; and (h) 4 choirs received the same ranking from the expert listeners: (1) no arm movement, (2) high circular gesture, and (3) low circular gesture.

These findings are confined to the protocols and participants in this study and should not be generalized to other populations. However, they merit consideration and can serve to contribute to the current research on singer gesture and provide discussion for future research in the area. I will discuss findings within the context of prior research, suggestions for future research, address limitations of the study, and discuss implications for choral music education.

Long-Term Average Spectra

Two of the three high school choirs sang with more resonance while performing one of the circular singer gestures, while five of the six middle school choirs sang with more resonance when singing with no arm movement. The high school choirs meet every school day and use singer gestures in their daily choir rehearsals; unlike the middle school choirs who also use singer gestures in rehearsals, but only meet one to three days a week. The ensembles that demonstrated more than 1 dB difference in their LTAS comparisons often struggle with energetic singing, out of tune singing, and maintaining breath support in spite of using gestures regularly in the choral rehearsal. The circular singer gestures seem to help these singers perform with better resonance and choral sound as confirmed by LTAS results.

The general comfort level of using singer gestures prior to the investigation might have led to more resonant singing. The high school singers in rehearsals more frequently use singer gesture than the middle school participants to help with particular singing techniques. Future research, longitudinal in nature, might discover if comfort and familiarity with using singer gestures plays a role in the effectiveness of singer gesture.

As a form of analysis, I did not include pitch analysis in this study. Intonation is one of the key components for use of physical movement in a choral setting (Brunkan, 2012; Cook-Cunningham & Grady 2017a, 2017b). A replication of this study with the inclusion of pitch

analysis would provide even more varied data to support an argument for singer gesture use in the choral setting.

An order effect may have influenced Choir E. Long-term average spectra results for Choir E demonstrate the high circular gesture and low circular gesture are almost exactly the same in an acoustic sense, and the choir sang with more resonance when singing with no arm movement. This ensemble recorded with no arm movement last, thus the repetition of singing and the addition of gestures may have helped their singing after the fact. However, since the preponderance of evidence in this study shows a middle school singer preference for "standing still and singing," perhaps, as middle school singers, they just preferred the non-gesture.

Each choir in this study is composed of unique voices and varying rehearsal schedules. Some choirs are small (n = 9-14 singers) and rehearsed infrequently while others are larger (n = 19-28 singers) and rehearsed frequently. Smaller and less-experienced choirs with less rehearsal time may have been uncomfortable trying a new singing situation that could, especially in a pre-teen-peer-situation, be deemed "embarrassing." Future research, might consider combining smaller choirs to make less-experienced singers feel more confident through larger numbers of singers. Also the addition of the gestures into regular rehearsals leading up to data collection could ease anxiety over new situations.

The researcher, based on frequency of use during regular choral rehearsals, selected the gestures for this study. Low circular gestures are common physical movements in the choral rehearsal (Brunkan, 2012; Brunkan, 2016) and the high circular gesture was chosen to contrast the low circular gesture to compare height of gesture results. For this study, use of singer gesture was for an entire song, whereas in the choral rehearsal, selection of gesture might aim at a particular pedagogical goal. Future research might include using gesture for specific moments in

the choral literature and not the entire piece.

In Brunkan's (2012) dissertation, singer participants performed excerpts with neutral vowels. Singer participants in this study mention being distracted by the gestures. Future research may consider replicating the current study with a neutral vowel instead of the use of text. The addition of singer gesture, particularly for inexperienced singers, may distract from text, rhythms, matching vowels, and memorization. Minimizing additional variables to pitch, rhythm, singular vowel, and gesture may make a difference in acoustic and perceptual measures.

Singer Participant Perceptions

Findings indicate a majority of singer participants enjoy singing with the addition of singer gestures. The use of singer gesture and physical movement adds interest and brings flexibility and energy to the choral rehearsal. After a day of sitting in desks and the stress of a math test, singer gestures within the choral context can help relax singers or distract them from focusing so much on the act of singing (Johnson & Jones, 2016; Martin & Murtagh, 2017; Mobley & Fisher, 2014; Zentgraf & Munzert, 2009; Brinson, 1996; Williamson, 2009).

For all choirs in this investigation, at least half of the choir members noticed a difference in choral sound while using the high circular arm gesture. Several students mentioned being able to sing with better phrasing or breath support while performing with the high circular arm gesture. The addition of the gesture may help the singer focus more on continuous airflow or maintain constant breath support with the physical reminder of the gesture that is also continuous (Apfelstadt, 1985; Hibbard, 1994; Manganello, 2011). Future research might include other gestures (arm or full-body, i.e., Dalcroze eurythmics) that are of continuous motion in connection to breath support or airflow in singers.

The majority of high school singers (Choir A, B, and C) noticed differences in vocal sound (n = 60, 80%) and choral sound (n = 58, 78%) when performing the low circular gesture. Further, most high school singers (n = 57, 77%) in this investigation reported perceived differences in their vocal sound while using the high circular arm gesture. On the contrary, many middle school participants did not perceive a difference in individual vocal sound or overall choral sound, yet many comments included physical fatigue from the same singer gesture. A younger adolescent and possibly pubescent or pre-pubescent singer may be so focused on their changing body that they may not be aware of differences or changes in singing with the addition of singer gesture.

Another issue singers that arose in singer responses is physical fatigue while singing with singer gestures. Although physical warm-ups and singer gestures are included in the regular rehearsal schedule some students are not physically active outside of the school day (Martin & Murtagh, 2017). Maintaining physical activity for an extended amount of time, only one minute in this case, may be difficult for some students causing discomfort and resulting in negative feelings toward singing with physical gestures. Before performing the excerpt, students also learned the gesture and practice it in tempo. Future research could examine utilizing physical gestures while singing for a range of time (shorter to longer segments).

Performances for this study were collected in one rehearsal period. This could be a confounding variable depending on a myriad of factors effecting students in a given day (weather, testing, sports, picture day, etc.). In the future, researchers may consider a study over a longer period of time, which includes physical activity and opinions of singer participants. Analyzing data where students may develop more stamina overtime with the consistent use of gesture may also be important to future research.

Singer responses indicate 5 of the 9 choirs perceive the high circular gesture to be more effective than the low circular arm gesture or singing with no arm movement. Considering the placement of the gesture, a high circular motion may create the feeling of a forward and upper resonance. Future research might include circular gestures of varying heights, sizes, and speeds to determine the "best fit" gesture for varied singing situations.

Within questionnaire responses, singers mention a perception of improvement in tempo maintenance, breath support, and choral tone quality with the addition of singer gestures. In addition, a few singers (n = 3) mention how the gestures may have been easier to perform with the conductor. In choral classes, students often implement physical movement simultaneously with the conductor (Peterson, 2000). Future studies may consider recording the conductor using physical singer gestures instead of a neutral conducting pattern.

Although some singers prefer singing without gestures, other students request more movement in their responses to the questionnaire. Participants mention wanting additional body part movements or full body movements while singing to increase energy and relaxation (Apfelstadt, 1985; Brinson, 1996; Brendell, 1997; Williamson, 2000). Future studies may contemplate similar methods as this investigation, but with the use of full body movements to understand possible effects on choral tone.

Johnson and Jones (2016) indicate the inclusion of physical movement may increase student energy and learning. This study adds to the vein of this current research as singer participants respond with an increase in energy to the choral sound with the addition of singer gesture. Future research may consider including questions about the increase or decrease in physical energy with the implementation of gestures.

Singer participant responses mention focusing on singer gesture and less on singing while

performing with physical movement. This finding might indicate that the addition of gestures may alter focus during singing and impact the overall choral sound. However, studies show that including physical movement may help students maintain focus (Zentgraf & Munzert, 2009). Future researchers may consider examining singer gesture and the correlation of singer focus.

The musical excerpt in this study was in the key of Ab major. For the majority of singers singing in the key of Ab major was seemingly very comfortable, while for others, it was either too high or too low due to adolescent changing voices. Therefore, future research might consider musical excerpts with smaller ranges or consider adjusting ranges based on choral ensemble needs. Changing the key may affect the overall tone quality of a choir and changes in resonance may occur to alter expert listener opinions on choral tone.

Expert Listener Perceptions

Overall, expert listeners did not agree on preferences of choral sound. Reasons for this discrepancy may include that several of the recordings demonstrated less than 1 dB JND in LTAS and the recordings were not of high quality.

One expert listener suggests that Choir D "sang with more consistent tone quality at the ends of phrases" while performing with the high circular gesture. The LTAS data demonstrate a small increase in resonance throughout the performance, which may support this expert's statement. The same expert commented, Choir E sings with "full and consistent tone quality" while singing with no arm movement. The majority of the LTAS data demonstrates lower spectral levels for the performance without arm movements and thus supports the claims of Daugherty, Brunkan, and Manternach (2012) that a lowered resonance in LTAS could lead to a more pleasing overall choral tone. Future research needs to better investigate what LTAS of choral sound is truly representing.

Conclusion

Findings of this investigation indicate that the addition of singer gestures may affect choral sound. Acoustic data, and perceptions of expert listeners and singer participants support this statement. However, not all results indicate positive changes with the addition of singer gesture.

Finding the right way to teach students how to sing healthfully and musically in a choir is one of the main challenges of teaching the voice. Singer gesture may be one of the tools to support singers in discovering how to sing with pleasing choral sound. Results of the present study warrant continued research on the effects of singer gesture on choral singing.

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Appendix A

APPROVAL OF PROTOCOL

KU THE UNIVERSITY OF KANSAS Research

APPROVAL OF PROTOCOL

April 19, 2018

Ashley Coffman
a903c949@ku.edu

Dear Ashley Coffman:

On 4/19/2018, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	THE EFFECTS OF THREE SINGER GESTURES ON ACOUSTIC AND PERCEPTUAL MEASURES OF CHORAL SINGING
Investigator:	Ashley Coffman
IRB ID:	STUDY00142329
Funding:	None
Grant ID:	None
Documents Reviewed:	• Email to Parents, • Eudora High School Administrative Approval, • Eudora Middle School Administrative Consent, • Human Subjects Protocol , • Parent Guardian Consent, • Participant Consent, • Participant Questionnaire, • Youth Assent

The IRB approved the study from 4/19/2018 to 4/18/2019.

1. Before 4/18/2019 submit a Continuing Review request and required attachments to request continuing approval or closure.
2. Any significant change to the protocol requires a modification approval prior to altering the project.
3. Notify HRPP about any new investigators not named in original application. Note that new investigators must take the online tutorial at https://rgs.drupal.ku.edu/human_subjects_compliance_training.
4. Any injury to a subject because of the research procedure must be reported immediately.
5. When signed consent documents are required, the primary investigator must retain the signed consent documents for at least three years past completion of the research activity.

If continuing review approval is not granted before the expiration date of 4/18/2019 approval of this protocol expires on that date.

Please note university data security and handling requirements for your project:
https://documents.ku.edu/policies/IT/DataClassificationandHandlingProceduresGuide.htm

You must use the final, watermarked version of the consent form, available under the "Documents" tab in eCompliance.

Sincerely,

Jocelyn Isley, MS, CIP
IRB Administrator, KU Lawrence Campus

Parent Guardian Consent

Parent-Guardian Informed Consent Statement

INTRODUCTION

The Department of Music Education/Music Therapy at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish your child to participate in the present study. You may refuse to sign this form and not allow your child to participate in this study. You should be aware that even if you agree to allow your child to participate, you are free to withdraw at any time. If you do withdraw your child from this study, it will not affect your relationship with this choral program, the services it may provide to you, or the University of Kansas.

PURPOSE OF THE STUDY

To study the effects three singer gestures on choral sound.

PROCEDURES

Your child will be asked to participate in three audio recordings of the *Eudora Alma Mater* after choral warm-ups in during one choir rehearsal. During each performance of the Alma Mater choral singers will sing with a selected gesture by the researcher. Your child will also fill out a short questionnaire. The entire procedure will take approximately 15 minutes.

The proceedings of this study will be audio recorded and will be used solely by the researcher. This performance will be recorded. Recording is (not) required to participate. You may stop taping at any time.

All proceedings will be transcribed by the researcher only. The tapes will be locked in a cabinet accessible only to the researcher and will be destroyed after a time period of one year.

RISKS

There are no foreseeable risks associated with the study.

BENEFITS

Your child will have the opportunity to learn a variety of singer gestures.

PAYMENT TO PARTICIPANTS

There will be no payment for participation in this study.
PARTICIPANT CONFIDENTIALITY

Your child's name will not be associated in any publication or presentation with the information collected about your child or with the research findings from this study. Instead, the researcher will use a study number rather than a name. Your child's identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission.

Permission granted on this date to use and disclose your information remains in effect indefinitely. By signing this form you give permission for the use and disclosure of your information for purposes of this study at any time in the future.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, your child cannot participate in this study.

Refusal to participate will not affect your grade in choir. Students who choose not to participate will rehearse in the band room with our choral accompanist on an alternative lesson.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent to allow participation of your child in this study at any time. You also have the right to cancel your permission to use and disclose further information collected about your child, in writing, at any time, by sending your written request to: Ashley Coffman (see address below).

If you cancel permission to use your child's information, the researchers will stop collecting additional information about your child. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

QUESTIONS ABOUT PARTICIPATION

Questions about procedures should be directed to the researcher listed at the end of this consent form.

PARTICIPANT CERTIFICATION:

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study. I understand that if I have any additional questions about my child's rights as a research participant, I may call (785) 864-7429, write to the Human Research Protection Program (HRPP), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7568, or email irb@ku.edu.

I agree to allow my child to take part in this study as a research participant. By my signature I affirm that I am at least 18 years old and that I have received a copy of this Consent and Authorization form.

_____ _____

Print Participant's Name Date

_____

Parent/Guardian Signature

Researcher Contact Information

Ashley K. Coffman
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785.864.9637
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Participant Consent Script

Informed Consent Statement

INTRODUCTION

The Department of Music Education/Music Therapy at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish your child to participate in the present study. You may refuse to sign this and not participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time. If you do withdraw from this study, it will not affect your relationship with this choral program, the services it may provide to you, or the University of Kansas.

PURPOSE OF THE STUDY

To study the effects three singer gestures on choral sound.

PROCEDURES

You will be asked to participate in three audio recordings of the *Eudora Alma Mater* after choral warm-ups in during one choir rehearsal. During each performance of the Alma Mater choral singers will sing with a selected gesture by the researcher. You will also fill out a short questionnaire. The entire procedure will take approximately 15 minutes.

The proceedings of this study will be audio recorded and will be used solely by the researcher. This performance will be recorded. Recording is (not) required to participate. You may stop taping at any time.

All proceedings will be transcribed by the researcher only. The tapes will be locked in a cabinet accessible only to the researcher and will be destroyed after a time period of one year.

RISKS

There are no foreseeable risks associated with the study.

BENEFITS

You will have the opportunity to learn a variety of singer gestures.

PAYMENT TO PARTICIPANTS

There will be no payment for participation in this study.

PARTICIPANT CONFIDENTIALITY

Your name will not be associated in any publication or presentation with the information collected about you or with the research findings from this study. Instead, the researcher will use a study number rather than a name. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission.
Permission granted on this date to use and disclose your information remains in effect indefinitely. By signing this form you give permission for the use and disclosure of your information for purposes of this study at any time in the future.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, you cannot participate in this study.

Refusal to participate will not affect your grade in choir. Students who choose not to participate will rehearse in the band room with our choral accompanist on an alternative lesson.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent to allow participation in this study at any time. You also have the right to cancel your permission to use and disclose further information collected about you, in writing, at any time, by sending your written request to: Ashley Coffman (see address below).

If you cancel permission to use your information, the researchers will stop collecting additional information. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

QUESTIONS ABOUT PARTICIPATION

Questions about procedures should be directed to the researcher listed at the end of this consent form.

PARTICIPANT CERTIFICATION:

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study. I understand that if I have any additional questions about my rights as a research participant, I may call (785) 864-7429, write to the Human Research Protection Program (HRPP), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7568, or email irb@ku.edu.

I agree participate in this study as a research participant. By my signature I affirm that I am at least 18 years old and that I have received a copy of this Consent and Authorization form.

_____ _____

Print Participant Name Date

_____

Participant Signature

Researcher Contact Information:

Ashley K. Coffman
Eudora Schools
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Faculty Supervisor:
Melissa L. Grady, Ph.D.
The University of Kansas
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Lawrence, KS 66045
Murphy Hall, 448J
785.864.9637
mlgrady@ku.edu

Youth Assent Form

Singer Assent Form

I am Ms. Ashley Coffman and I am interested learning about different types of singer gesture. If you would like, you can be a part of my study through this choir.

The study will take place after choral warm-ups during one choir rehearsal. First, you will fill out a short questionnaire about how your voice feels that day. Next the choir will participate in a warm-up procedure. After the warm-up, the entire choir will sing the *Eudora Alma Mater* (the *Alma Mater* will be audio recorded). Finally, you will complete a short questionnaire about what you liked and did not like about the singer gestures. The entire process will take about 15 minutes.

Refusal to participate will not affect your grade in choir. Students who choose not to participate will rehearse in the band room with our choral accompanist on an alternative lesson.

There are no risks to you or your voice in the study. In fact, you might learn some new singer gestures to use. The data I collect in this study will be useful to choir directors in selecting singer gestures for choral rehearsals.

The recordings of the choir and the information I collect from you will be private, and I will destroy the recordings once I have made a record of what I learn. When I tell other people about my research, I will never use your name.

The proceedings of this study will be audio recorded and will be used solely by the researcher. This performance will be recorded. Recording is (not) required to participate. You may stop taping at any time.

All proceedings will be transcribed by the researcher only. The tapes will be locked in a cabinet accessible only to the researcher and will be destroyed after a time period of one year.

Your (mom/dad/parents/guardians) have said it is okay for you to be in this research study. You do not have to be in this study if you do not want to. If you choose to participate and want to stop at anytime, you can tell me by saying, "I would like to stop."

Please mark one of the choices below:

_____ **NO,** I do not want to be in this study. _____ **YES,** I want to be in this study.

_____ _____

Name Date

_____ _____

Signature of Person Obtaining Assent (optional) Date

Appendix B

Participant Questionnaire
To be completed before class begins

Age:_____ Grade or year in school:_____ Male or Female (circle one)

Number of years in choir: _____

Number of years in voice lessons: _____

Are you experiencing any vocal problems today? _____Yes _____ No

Do you currently have any health issues that are affecting your voice?

_____Yes _____No

Complete after Gesture 1 procedure:

Did you notice a difference in your vocal sound? _____ Yes _____ No

Did you notice a difference in the choral sound? _____ Yes _____ No

Please rate the effectiveness of this singer gesture:

1	2	3	4	5
Not helpful		Somewhat helpful		Very helpful

Complete after Gesture 2 procedure:

Did you notice a difference in your vocal sound? _____ Yes _____ No

Did you notice a difference in the choral sound? _____ Yes _____ No

Please rate the effectiveness of this singer gesture:

1	2	3	4	5
Not helpful		Somewhat helpful		Very helpful

Complete after Gesture 3 procedure:

Did you notice a difference in your vocal sound? _____ Yes _____ No

Did you notice a difference in the choral sound? _____ Yes _____ No

Please rate the effectiveness of this singer gesture:

1	2	3	4	5
Not helpful		Somewhat helpful		Very helpful

Complete after all three singer gesture procedures:

Did you enjoy the addition of a singer gesture? _____Yes _____No

Write what you did or did not like about the singer gestures.

Appendix C

Expert Panel Demographics Questionnaire

Name: _____

Age: _____years

Sex (circle one): Male Female

Years of Teaching Experience:

General Music: _____years
Choral Music: _____years
Studio Voice: _____years

Appendix D

LTAS Charts of Singer Gesture Performances

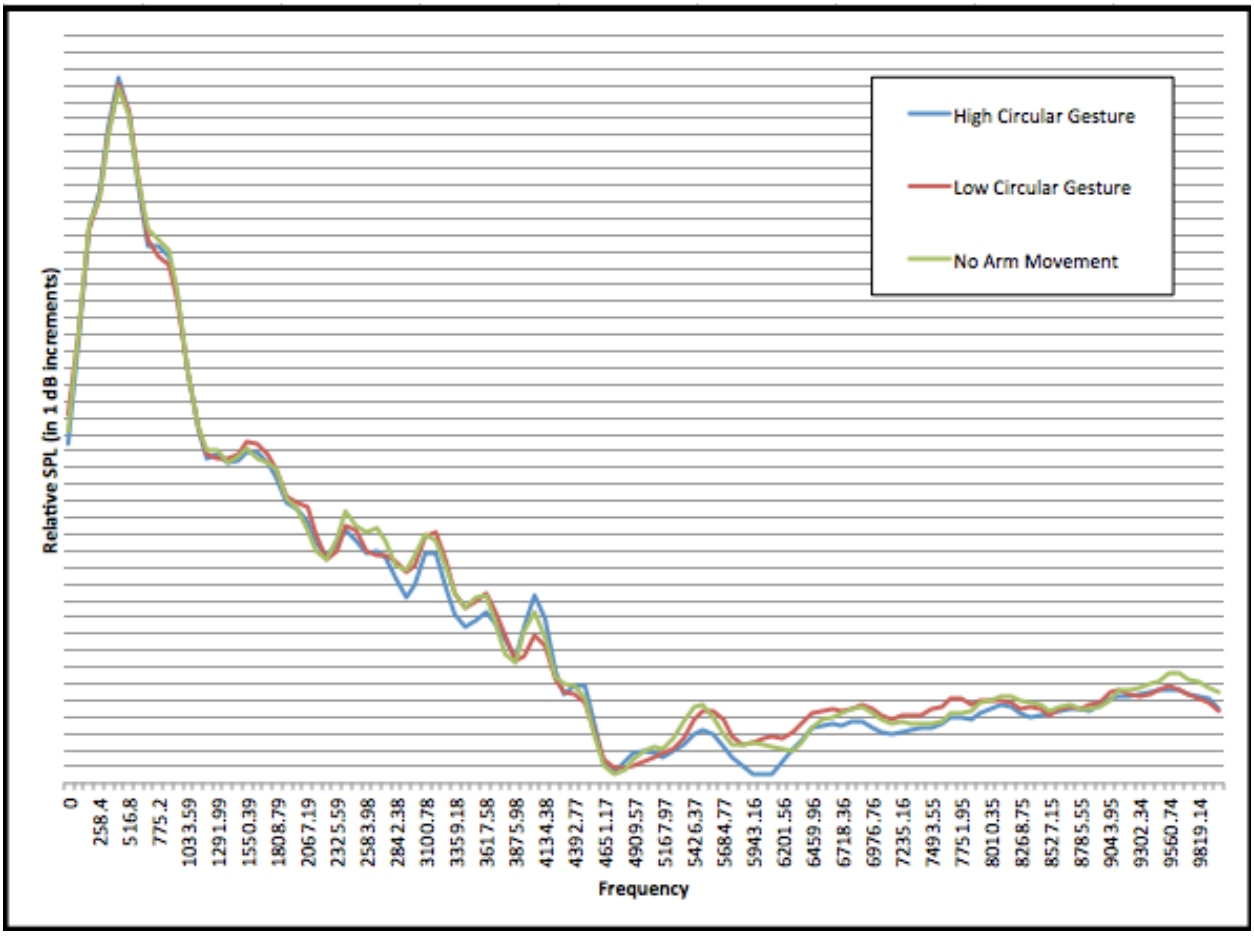

Figure 6. Choir A: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

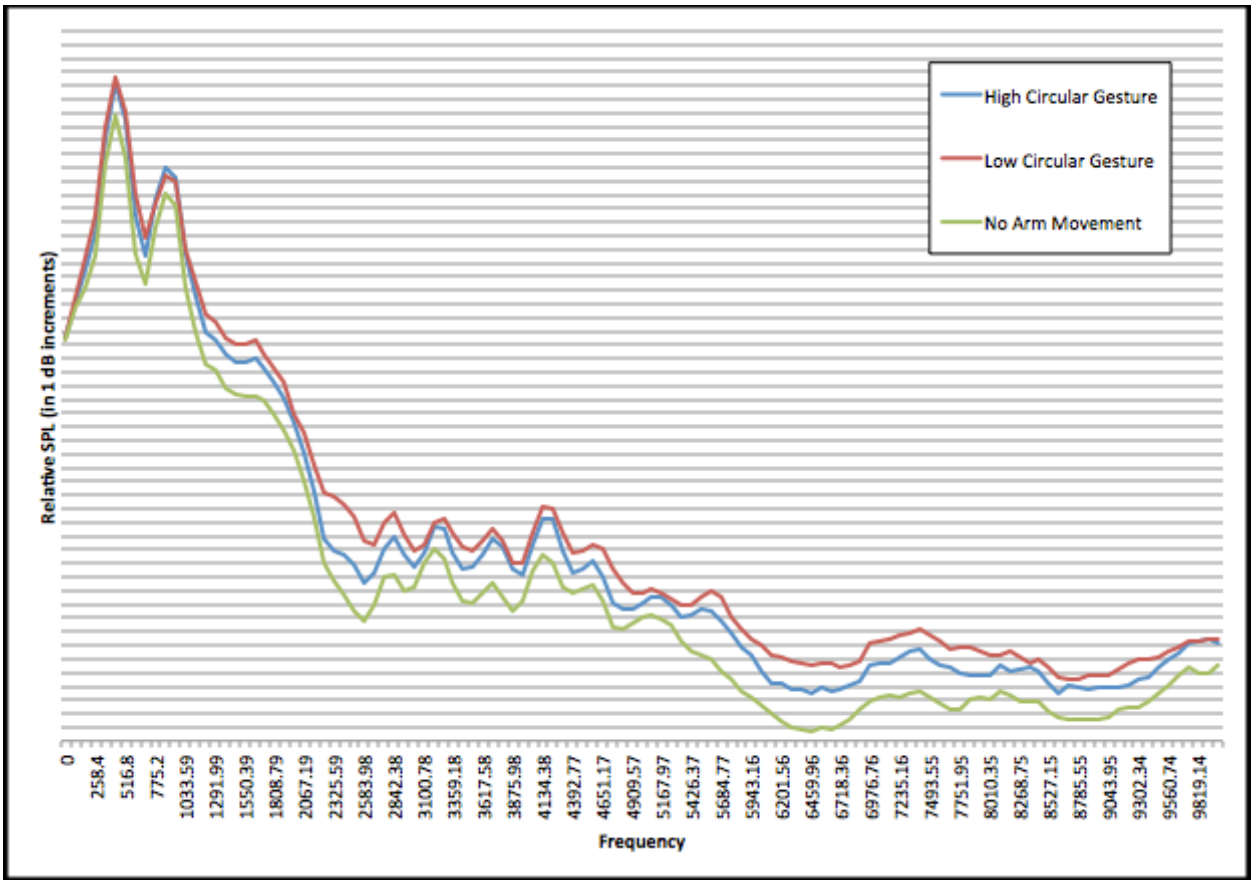

Figure 7. Choir B: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

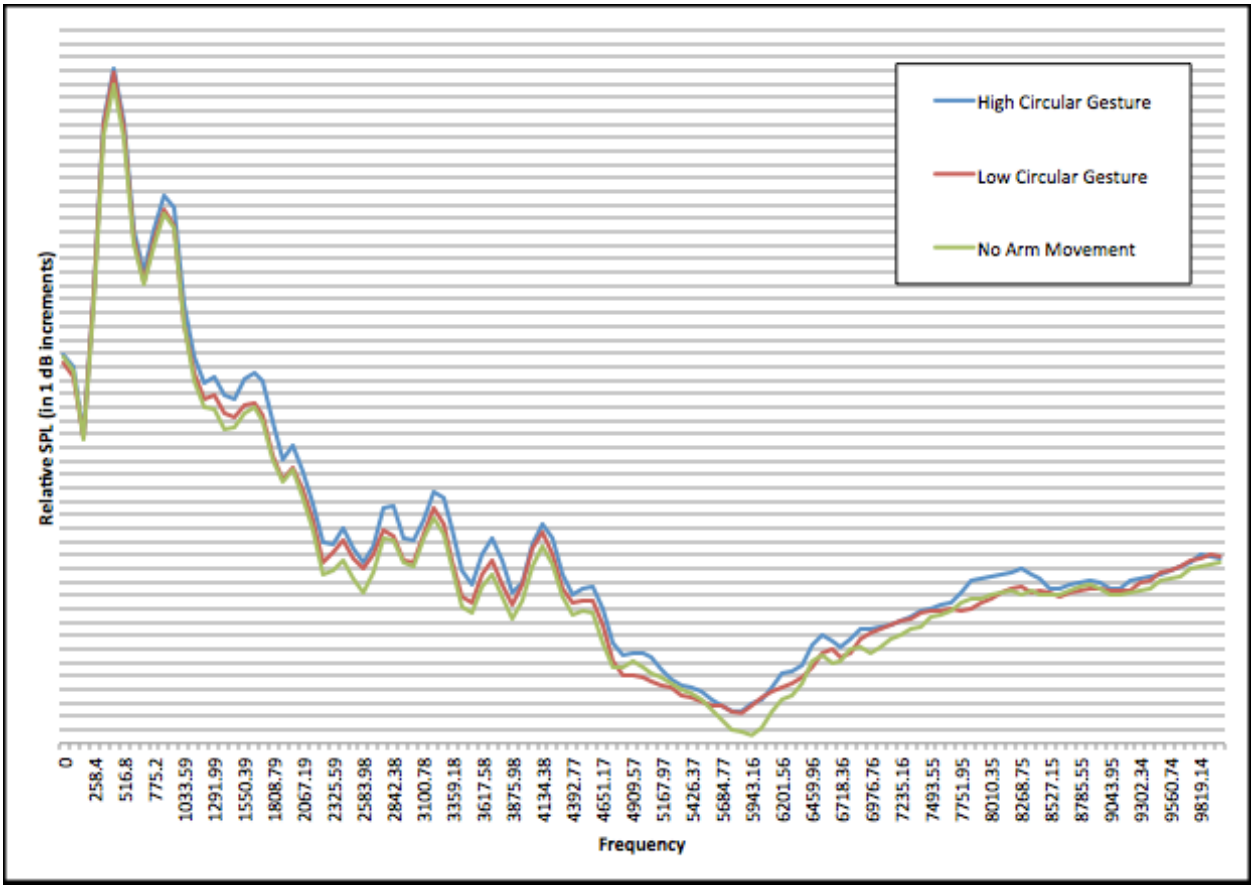

Figure 8. Choir C: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

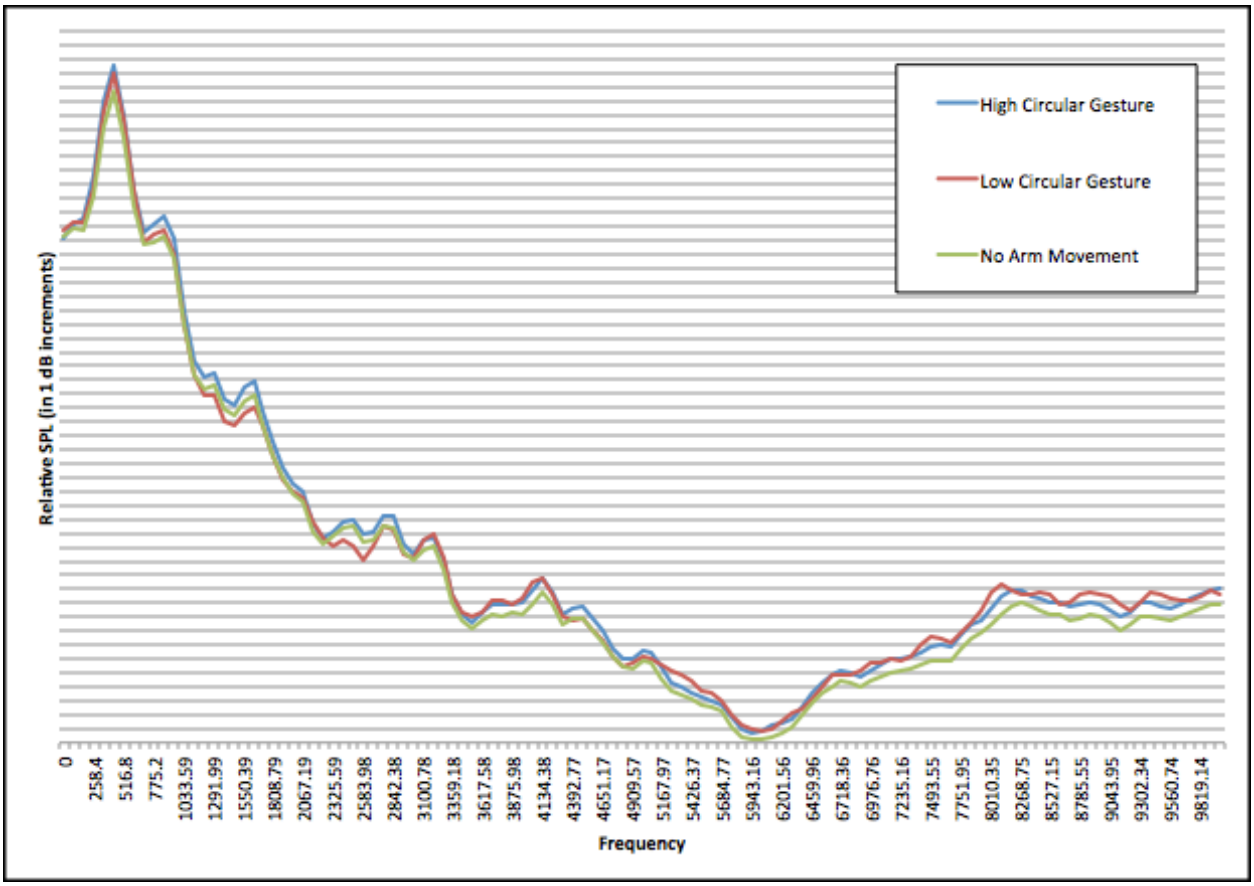

Figure 9. Choir D: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

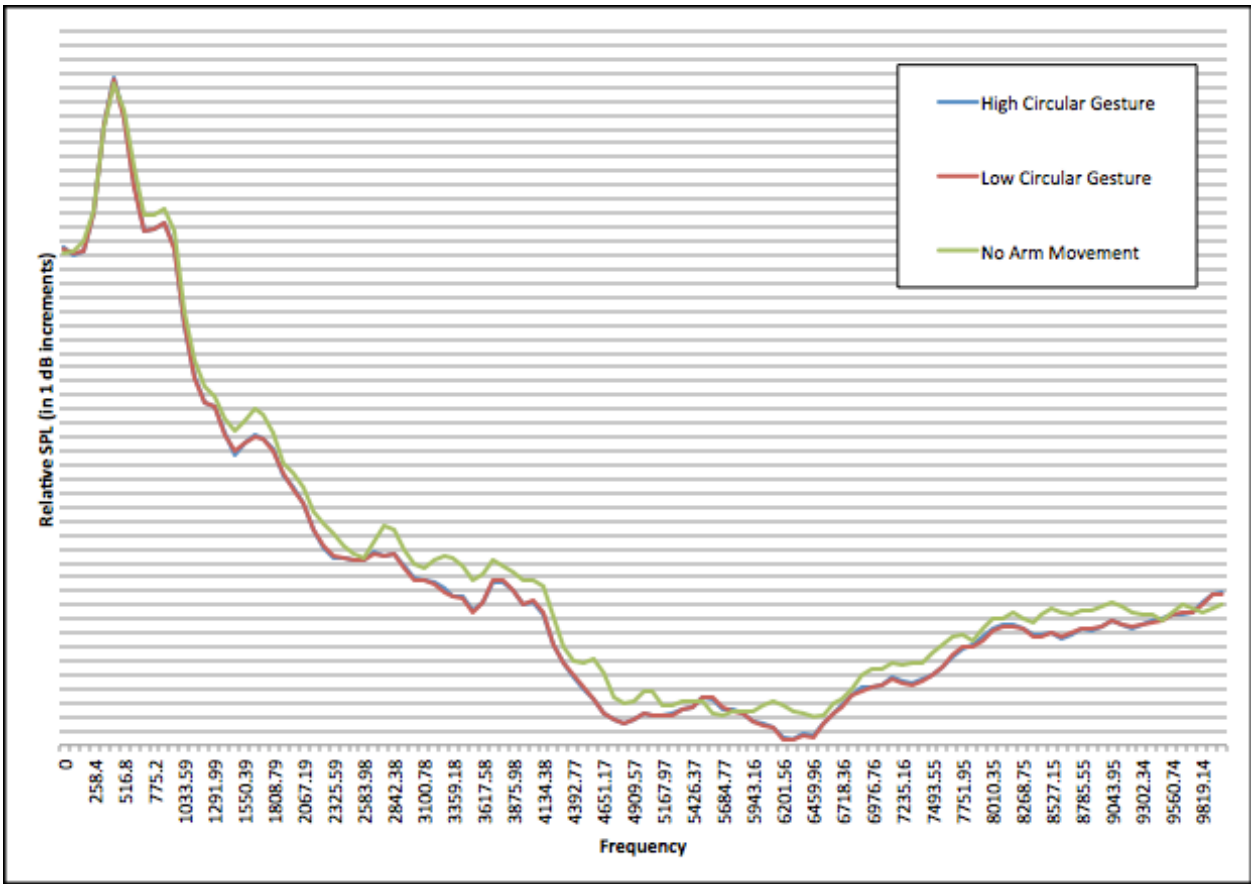

Figure 10. Choir E: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

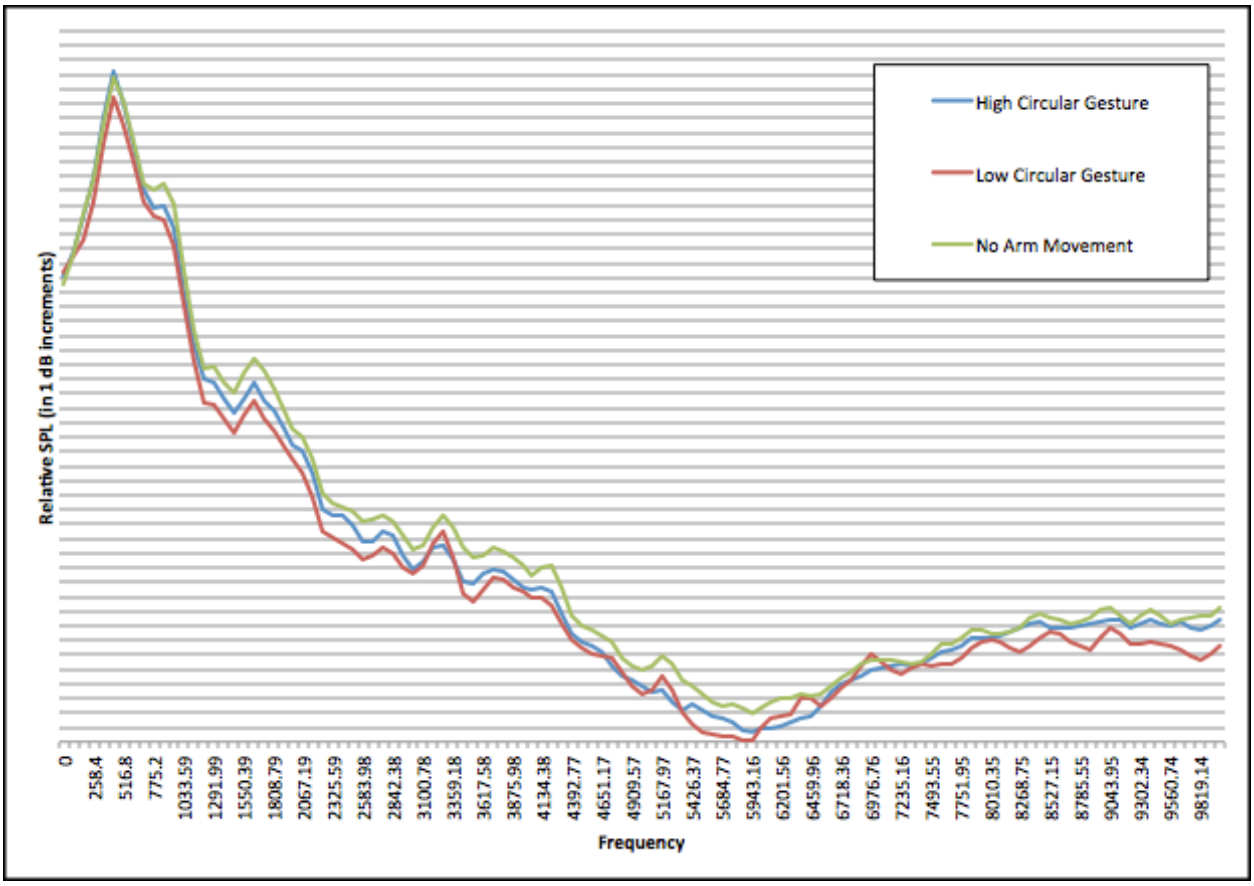

Figure 11. Choir F: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

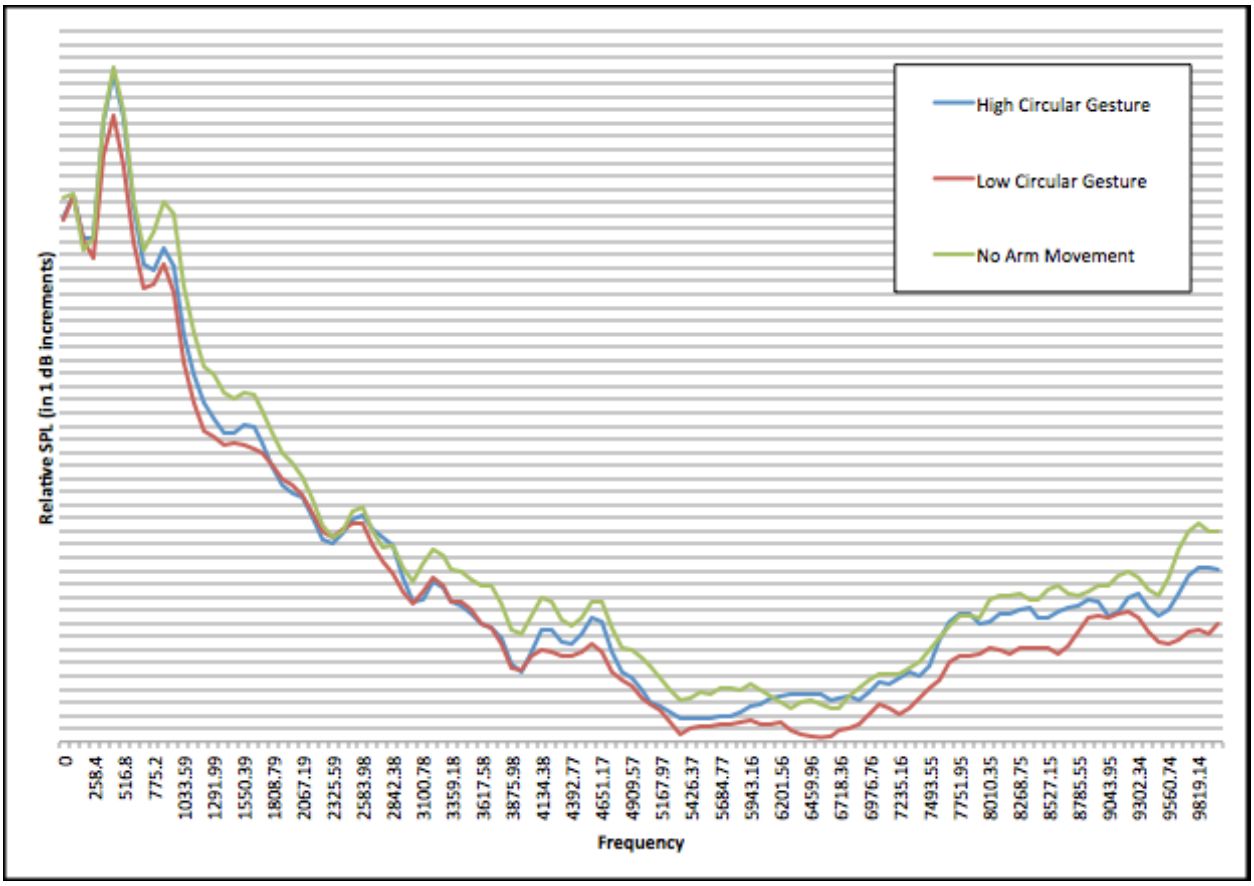

Figure 12. Choir G: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

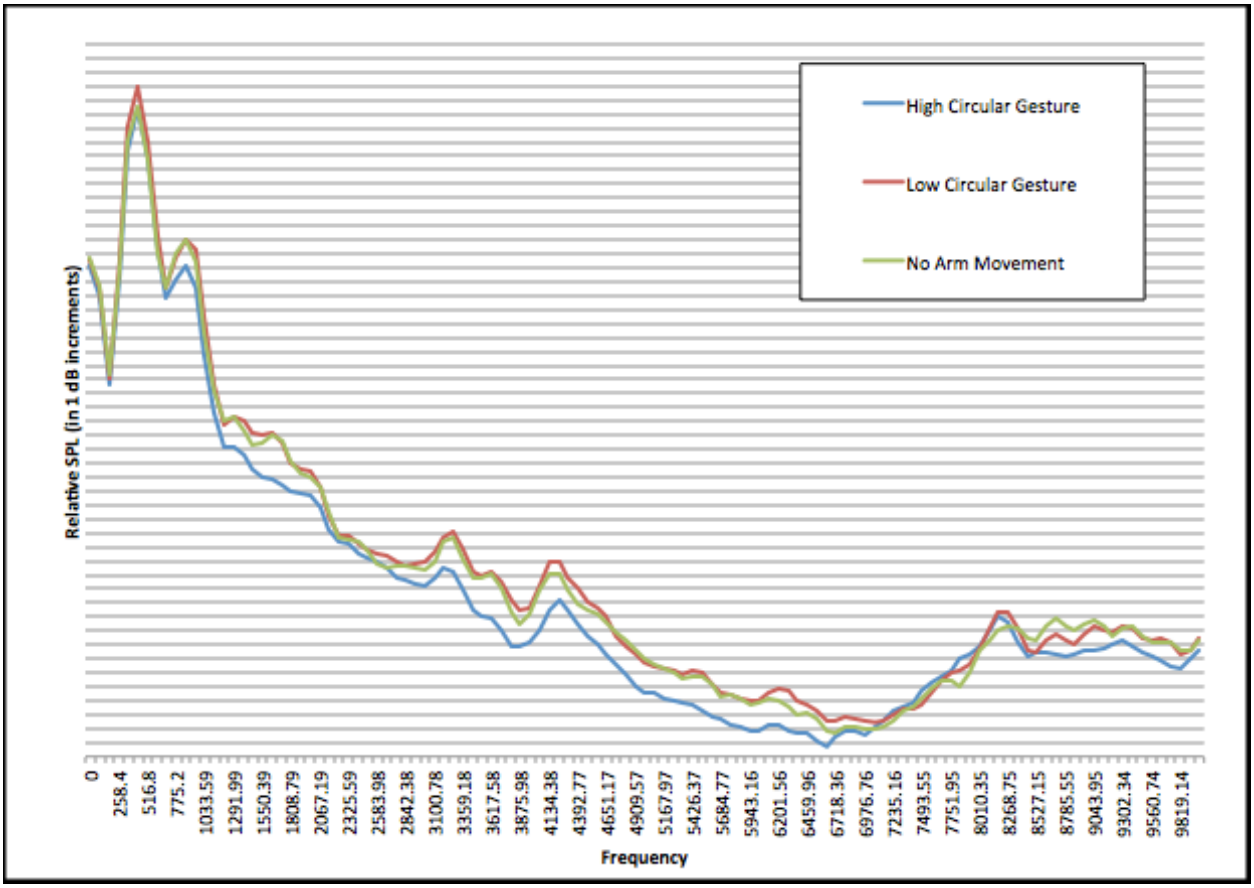

Figure 13. Choir H: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.

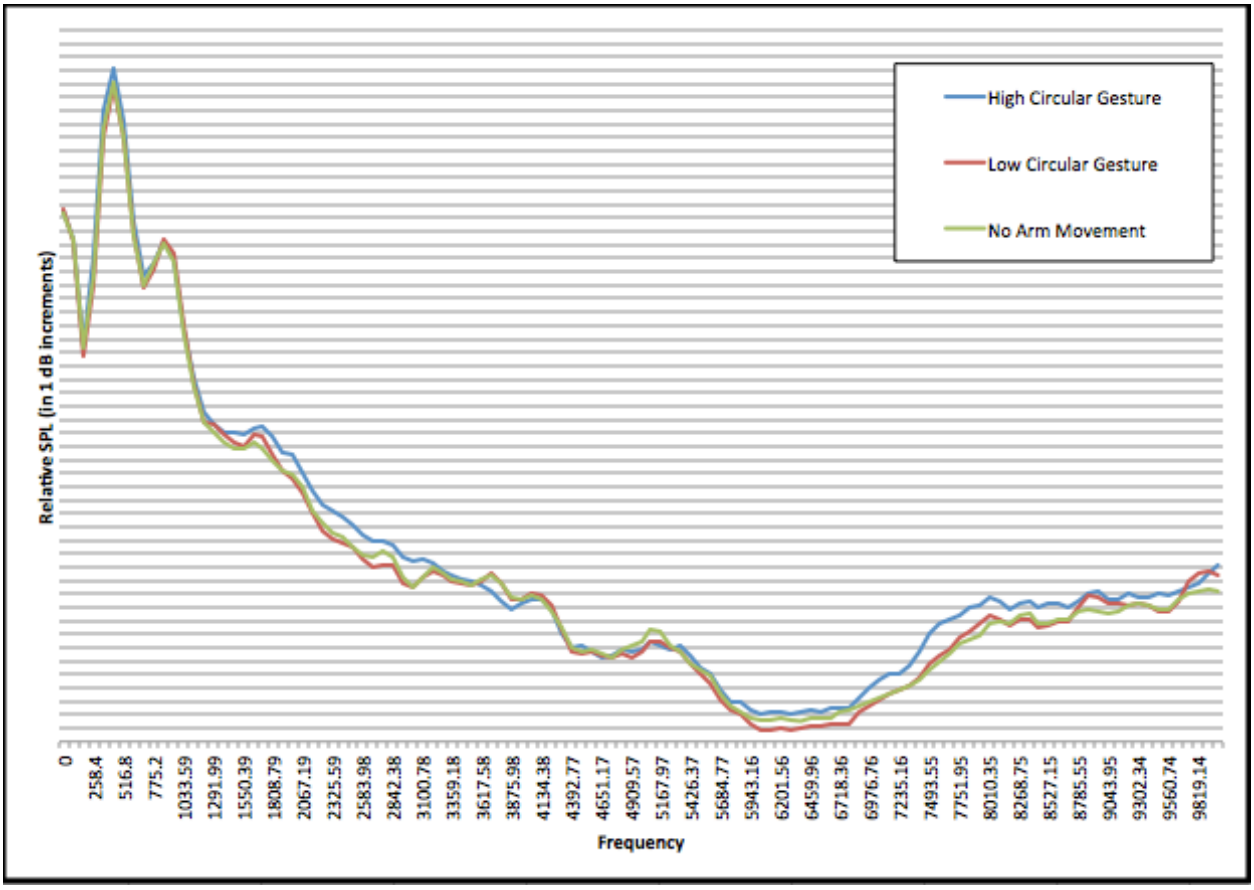

Figure 14. Choir I: Entire spectrum (0-10 kHz) LTAS of high circular arm gesture, low circular arm gesture, and no arm movement.